VENTILATING

A MONTHLY MAGAZINE FOR ENGINEERS AND CONTRACTORS CONCERNED WITH COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL AIR CONDITIONING, REFRIGERATION, AIR SANITATION, PIPING, HEATING AND VENTILATION

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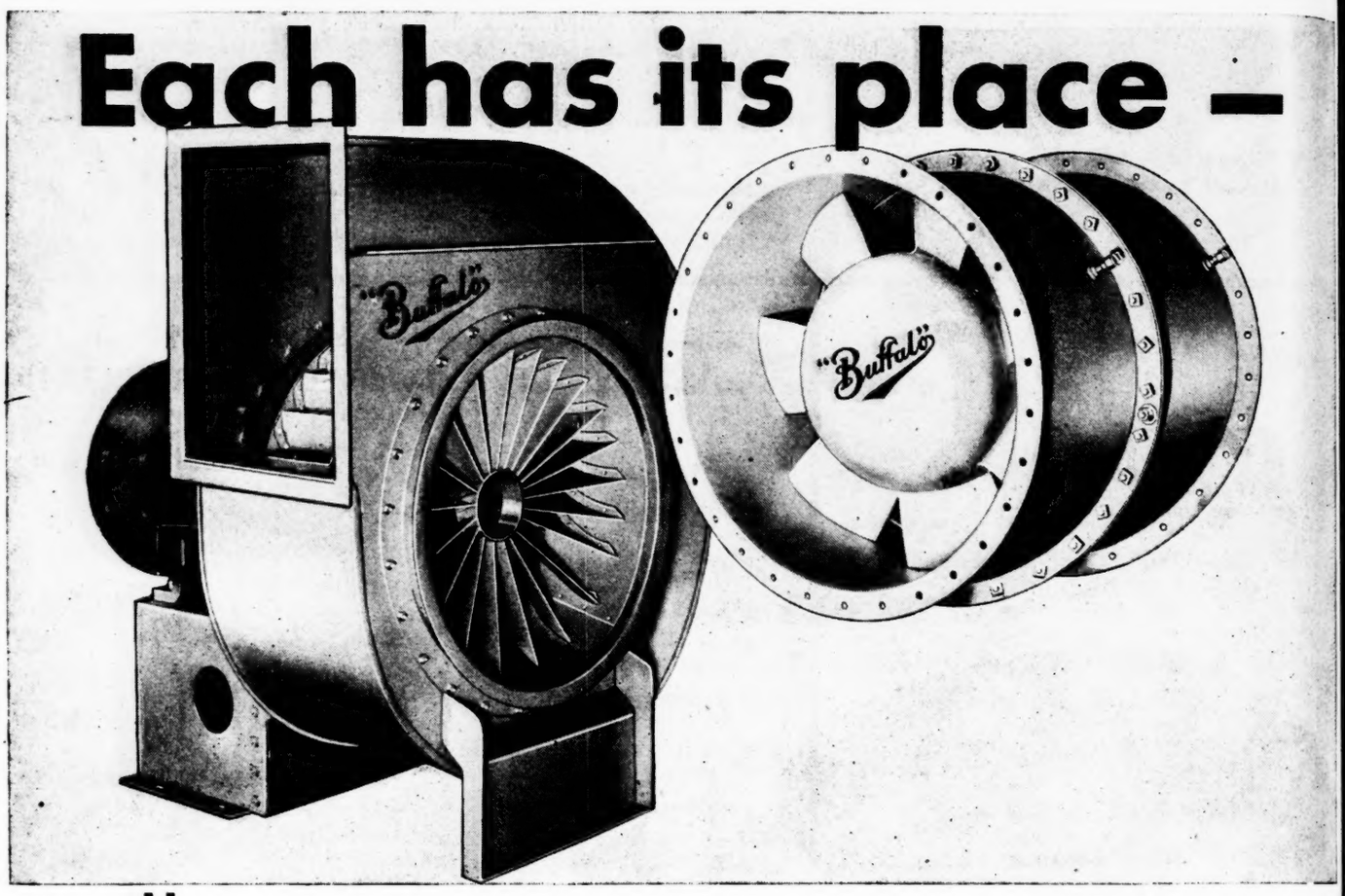
NEXT MONTH'S ISSUE

Radiant heating system designers must decide where to place the panels. In an article next month, there will be a discussion of the advantages and disadvantages of the ceiling, wall and floor systems. The findings should prove most interesting.

Each has its place —



In this age of industrial, military and professional specialization, every piece of equipment should "stand on its own legs." In the fan industry the relatively new axial flow fan meets many special installation requirements. It is ideal for the low pressure service encountered in air conditioning, ventilating and some industrial work.

On the other hand, the old, highly-developed centrifugal fan is usually better where the duct system requires elbows or bad connections near the fan inlet or outlet; or where pressures above 5" or 6" static are encountered, or where heavily dust-laden air is handled.

Buffalo builds both Axial-Flow and Centrifugal Fans in complete lines. Buffalo Sales Representatives, located in all principal cities, are free to recommend the type and style which will most efficiently handle your job. Ask for their unbiased recommendations.

Buffalo Forge Company

480 BROADWAY • BUFFALO, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

ARMY E NAVY

"Buffalo"
"First For Fans"

"LIMIT-LOAD" CENTRIFUGAL and AXIAL-FLOW FANS

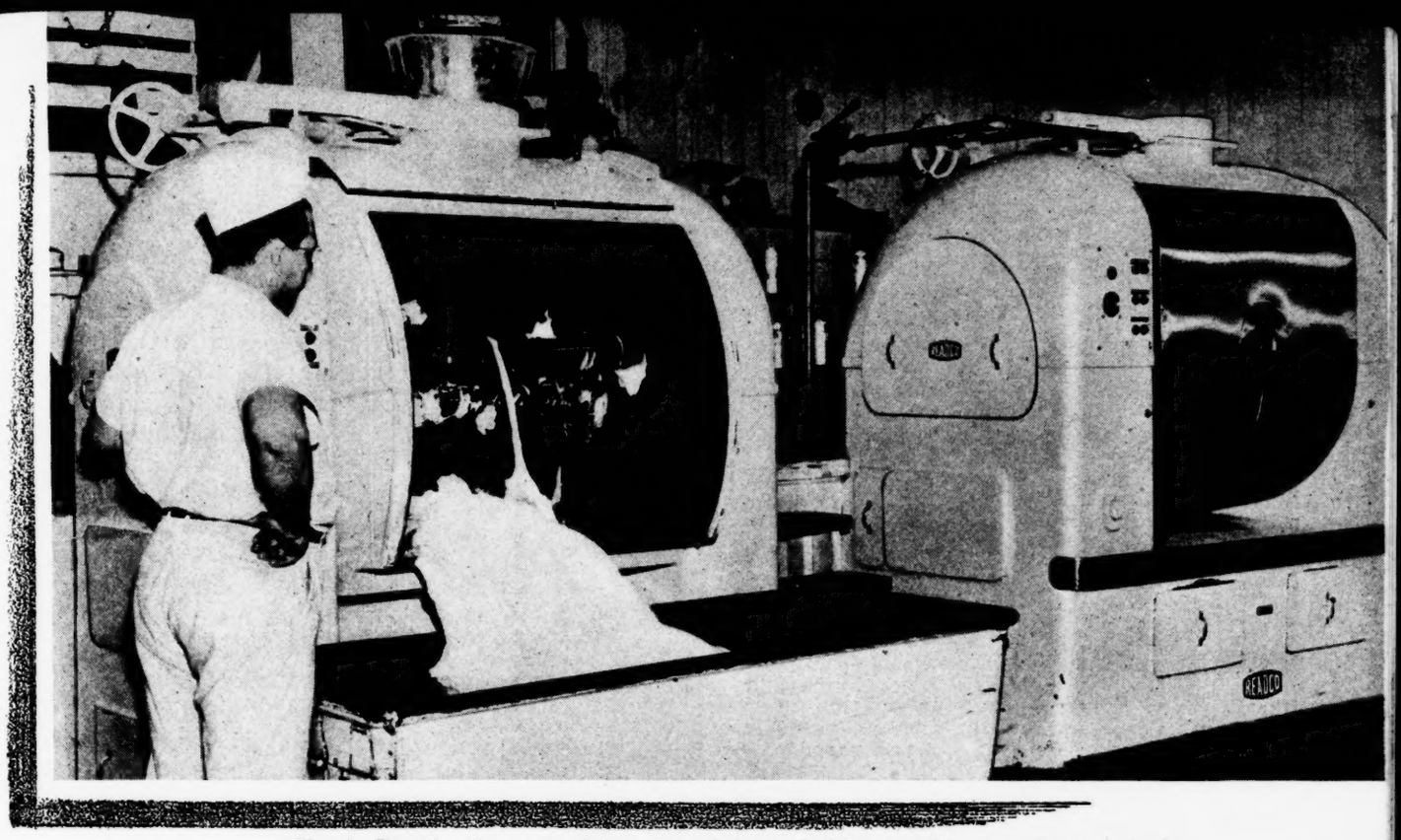


Fig. 1. Dough mixers must be adequately cooled for good temperature control.

Refrigeration and Air Conditioning Required in Bread Bakeries

DWIGHT TENNEY
Consulting Engineer, Verona, N. J.

SINCE the dawn of history, men have ground wheat to a fine powder, mixed it with water, and baked the mixture into unleaven bread. It is only within recent years that baking has come out of that state and has become a precise scientific industrial process. To better understand the important role played by refrigeration and air conditioning in the baking industry, let us look at the fundamental processes that take place in a modern bakery.

Basically the production of good bread depends very largely upon the life development of microscopic yeast plants. These cells, which act very much as plants we see around us every day, propagate luxuriously and rapidly in hot moist climates, as vegetation growths in the tropics. On the other hand, cold and arid conditions greatly retard or may completely arrest their reproduction. Basically, the baker is operating a microscopic florist shop. There is however one fundamental difference between plant life and yeast cell development. Plants, due to the presence of chlorophyl, convert carbon dioxide into oxygen, whereas yeast digests the starches and sugars upon which it grows and changes them into carbon dioxide and by-products. So much for the fundamental chemical process that takes place in the manufacture of dough.

As climate affects plant life, so in bakeries we find temperature and humidity greatly governing the development of bread dough. Fig. 3 shows how refrigeration and air conditioning enter into the various stages of bread production.

Raw materials that, generally speaking, go into making an ordinary loaf of bread are:

Flour	55½%
Water	33½%
Condensed milk	7½%
Shortening	1½%
Yeast	1%
Malt	½%
Sugar	½%
	100%

These ingredients are accurately weighed and mixed in large powerful mixers to form single batches weighing from 800 to 1,000 pounds. Were it not for the 1% of yeast, very little chemical reaction would take place in the subsequent processes, and the resultant mass when divided and baked out would result in flat, hard, flinty loaves of unleaven bread. But the 1% of plant life that has been added changes the entire picture.

Modern bread gets its texture, color, and flavor from the action of yeast, and since yeast is a

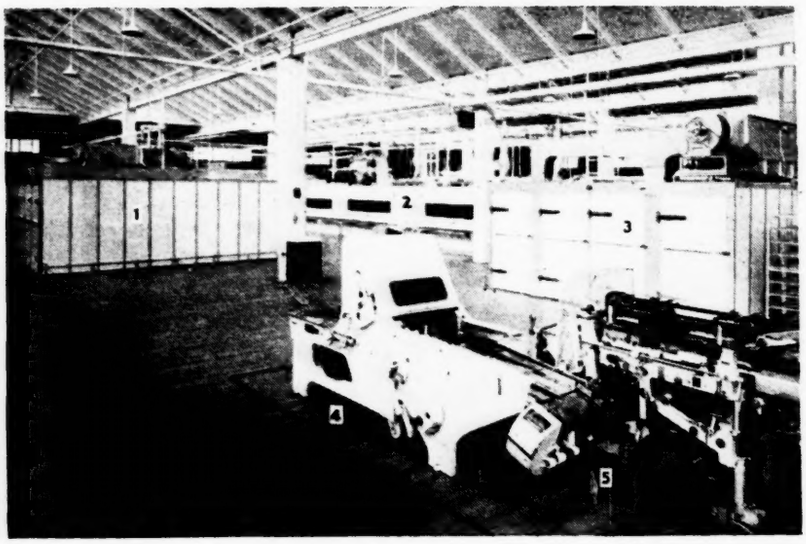


Fig. 2. Bread Bakery of National Biscuit Co., Syracuse, N. Y. The various units are: 1, proof-box; 2, bake ovens; 3, bread cooler; 4, bread slicer; 5, bread wrapper.

plant, its growth is influenced by the temperature and humidity of its environment. Therein is the importance of air conditioning and refrigeration in the baking industry.

When yeast is first broken up and mixed with the other ingredients, it is inert for it has been stored in refrigerators where its growth was arrested. Yeast cells start to multiply as soon as mixed with flour and water. From this point on, cell growth is controlled by the temperature at which the cells are permitted to develop. Yeast is extremely sensitive to even the slightest temperature changes. For example, let us consider a type of loaf that requires a temperature of 78F in the dough mass leaving the mixer. If through error the mass comes out at 77F it is a "cold dough", while on the other hand if it should come out at 79F it would be a "hot dough." Temperature tolerances are that close.

Refrigeration enters the picture because the temperature at which a dough is discharged from the mixer depends upon:

a. Temperature of flour entering the mixer
b. Temperature of water entering the mixer
c. The amount of work done during the mixing, which in turn depends upon,
   1. Formula
   2. Type of flour used
   3. Type of mixer used
   4. The length of time consumed in mixing
d. Heat removed during the mixing period.

The importance of these factors is best understood by noting the following:

TABLE 1.—RESULTS OF TEMPERATURE CHANGE ON FINAL DOUGH TEMPERATURE.

Temperature change	Effect on final dough temperature
A change of 1oF in the ingredient flour.....	3F
A change of 1oF in the ingredient water....	5½F
A change of one minute in mixing time.....	¾F
A removal of 10,000 Btu/hr during cycle....	2F

Heat generated by the work of mixing is largely effected by the length of time that the dough is mixed, and cannot be altered for dough of like formula because the mixing not only brings the ingredients into intimate contact, but it stretches the gluten that is formed, much like an old-fashioned taffy pull. Under-mixing leaves the gluten underdeveloped, over-mixing breaks it down. Thus the mixing time must be held constant and consequently the heat generated will be practically constant.

It is also rather impractical to attempt to reduce the temperature of the flour, especially in the summer when the reduction is most needed. Only a small amount of cooling will bring the flour temperature below the dew point where it will start to absorb water and become lumpy. The baker cannot sell bread full of lumps. To obtain the best quality bread, the flour must be stored for some time to age. During this aging process the flour will lose weight through moisture evaporation and for this reason some flour storerooms have been air conditioned. However, it is the writer's opinion that losses at this point are more apparent than real, as the moisture can be corrected later when the water is mixed with the flour in the mixer. Storage losses will vary from ½ to 2% depending upon the location of the storage warehouse and the season of the year.

Chilled Water Used for Mixing

We now come to a first prime use of refrigeration in the bakery, the chilling of the ingredient water. From Table 1 it will be noted that this temperature has a relatively large effect on the final temperature of the dough. If the baker could chill his water to 33F and circulate similarly chilled water through his mixer jacket, he could get the desired dough temperature during the greater part of the year. But cooling water down to 33F without freezing it is no easy job. The enlightened baker gets his 33F by recirculating the water over Beaudelot cooler coils; others plug along as best they can with 40 to 45F water. Here is a big chance for the refrigeration engineer to educate the baker. An average size commercial baker mixing about 2,500 pounds of dough per hour will have an ingredient cooling water load of roughly 30,000 Btu/hr.

The next important part for refrigeration is to remove the heat produced by the work of mixing. Large high-speed jacketed mixers are used, driven by 25 to 50 hp motors. Heat generated in the mixing of an 800 pound dough is 23,000 Btu/hr.

When modern bakery practice was in its infancy, the baker attempted to overcome this heat of mixing by substituting cracked ice for part of the ingredient water. While it worked after a fashion in the old slow speed mixers, it was sloppy and required mathematical calculations to insure that the proper amount of water had been introduced. But when the

present high speed mixers came into use, the mixer bowls were encased in a jacket so that cold water or brine could be circulated about the mixer shell. Although extensively used today, neither of these media is highly satisfactory. It is difficult to get water down to 33F and brine chilled at a central point is not only hard to handle but the same brine when used for a number of other purposes is hard to control.

During the past few years attempts have been made to secure the desired mixing bowl cooling by expanding refrigerant directly in specially built jackets. To date, because of mechanical troubles and the difficulty of maintaining control with widely varying loads and temperatures, this method has been a keen disappointment to many bakers.

Much has to be learned about applying refrigeration in the mixing process.

After the dough is removed from the mixer at a predetermined temperature that cannot vary over plus or minus ½F, the dough must rest to give the yeast cells an opportunity to grow. The trough into which the dough is dumped from the mixer is pushed into a room that the baker calls a "dough room". For a great many years a dough room was considered properly conditioned if it was maintained at 80F dry bulb and 76% relative humidity. To maintain these conditions only a slight amount of refrigeration is required in most parts of the United States during the summer and a great deal of humidification in the winter.

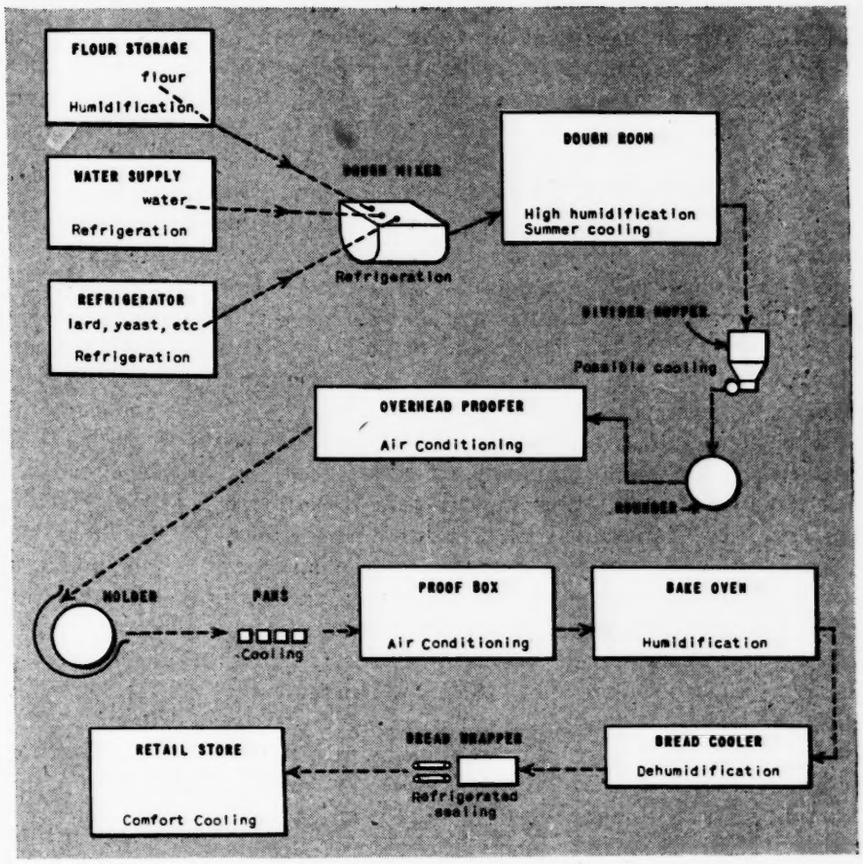


Fig. 3. How air conditioning and refrigeration are employed in baking bread.

Influence of Humidity

During recent years, bakery engineers have been questioning the correctness of the 80F-76% empiric formula. Many believe that a much higher humidity is necessary for quality fermentation. A high humidity during the three hours that the dough is developing prevents the evaporation of water from the mass. Evaporation has a double evil. First, it drys the surface so that there is formed a hard skin or lumps. Secondly, by evaporation the upper layers of the batch are cooled. Since the fermenting processes produce heat and evaporation produces cold, it is apparent that the mass will assume spotty temperatures. As yeast development is very sensitive to temperature changes, it can be easily seen that the dough will proof without uniformity.

The conditioning of bakery dough rooms calls for further study.

After the dough has rested in the dough room from three to four hours, the yeast has produced a remarkable change in the dough mass. Its original volume has increased about eight times because of the CO_2 generated and a fine flavor has developed as a by-product of the digested starches and sugars.

From the troughs, the dough is now dumped into the hopper of a machine, called a divider, where the mass of dough is divided into individual loaves. The mass is roughly treated in the process to expel most of the gas produced by fermentation. Most dividers are located on the oven floors, the ceilings of which get pretty hot at times. The divider hopper holds a full batch of dough, some of which may remain in the hopper as long as 20 minutes at high heat, and become badly over-proofed. To the writer's knowledge, nothing has been done to condition the environment of the hopper.

Dough Formed into Balls

The dough loaves leave the divider and pass automatically into a "rounder" which rounds the dough into balls. By the time the divider and rounder have gotten through punching and kneading, the spring and life have been pretty well knocked out of the dough. Individual loaves are discharged from the rounder on to a long series of conveyor belts or buckets, where for 15 minutes the yeast is given another chance to develop and put life back into the loaves. This conveyor system is located under the ceiling, to be out of the way, and is therefore called an overhead proofer. During recent years, bakers have installed air conditioning units to control the fermentation that takes place in the overhead proofers. But this development is new.

The re-enlivened dough balls automatically pass from the overhead proofer into the molder, where the balls are changed to loaf-shaped items and then placed in baking pans. The molder is one machine that does not require the attention of the refrigeration or air conditioning engineer. But the pans present another problem. When the pans receive dough for the first cycle through the proof-box and oven, they are relatively cold. But after the pans pass through the oven and come back for subsequent cycles they are hot. This affects materially the yeast action in the proof-box. Some day, something may be done about cooling and tempering these pans.

The dough-filled pans are placed on racks and pushed into a room commonly called a proof-box, for the final fermentation stage before baking. In this room is maintained air conditioning of such refinement as to tax the ingenuity of the air conditioning engineer. Pans of dough rest on racks so that while some of the pans are only a few inches off the floor, those on the top shelves are six feet above it. All pans must be subjected to the same temperatures and humidities, and no drafts that would crust the dough can be tolerated. The conditions maintained in the proof-box are 98F and 90-95% relative humidity. The dough rests in the proof-box for about 40 minutes, and during this period CO_2 is again generated. The dough rises and fills the pans, until the loaf of dough is ready for the bake oven. Where the baker has called in air conditioning engineers, a rather good job of air conditioning these difficult proof-boxes has resulted. Exacting requirements of uniformity of temperature and humidity were obtained at all levels and in all positions.

Oven is Air Conditioned

Loaves of dough finally proofed are placed in the bake oven. While the oven is maintained at approximately 450F, during the entire baking process the white inner crumb of the bread never gets above the boiling point of water. An interesting sidelight is that bread baked in higher altitudes, like Great Falls, Mont., will bake at much lower temperatures than bread baked in New York City, and the baker can do nothing about it. However, the temperature in both places is high enough to kill the yeast cells. Although many reactions take place during the baking, since they are not affected by air conditioning, they will not be discussed here.

However, despite the fact that the oven temperature is controlled over 400F, after a fashion, the oven interior is air conditioned. To obtain the glossy sheen on the crust of bread, it is necessary to secure a high humidity over the surface of the loaf while baking. To do this the older bakers used to throw water into the baking chamber. Although this was pretty hard on the oven, it achieved the desired results. Today wholesale bakeries blow low pressure wet steam on the bread while it is baking. Even though this steam quickly becomes superheated, it does the job fairly satisfactorily. However, much has to be learned about oven air conditioning.

When the bread leaves the oven, our old friends the yeast cells are no longer alive. However, the bread is exposed to another microscopic plant, the mold spore. If bread were not wrapped in a moisture-proof wrapper to maintain its freshness, the services of the refrigeration engineer could be dispensed with at this point. But most bread is wrapped.

Due to the high oven temperature, a high vapor pressure is developed in the bread while it is baking, and a large amount of moisture is driven from the bread while it is cooling. If this moisture-exuding loaf is wrapped before it reaches room temperature, the moisture given off will collect inside the wrapper and on the crust of the bread to form a soggy loaf and to convert the crust into an excellent breeding area for mold spores. With few exceptions the art of bread cooling has been very badly handled to date. If the humidity is kept relatively low about the bread so that evaporation can take place freely, the bread will largely cool itself through the loss of latent heat. This principle is used to accelerate cooling by means of the vacuum cooler, which cools bread very quickly. However, the vacuum pulls off the low-boiling point alcohol and ketones, and with them the flavor. The vacuum cooler has not proven a success in bakeries. Many of the so-called bread coolers actually retard the cooling process.

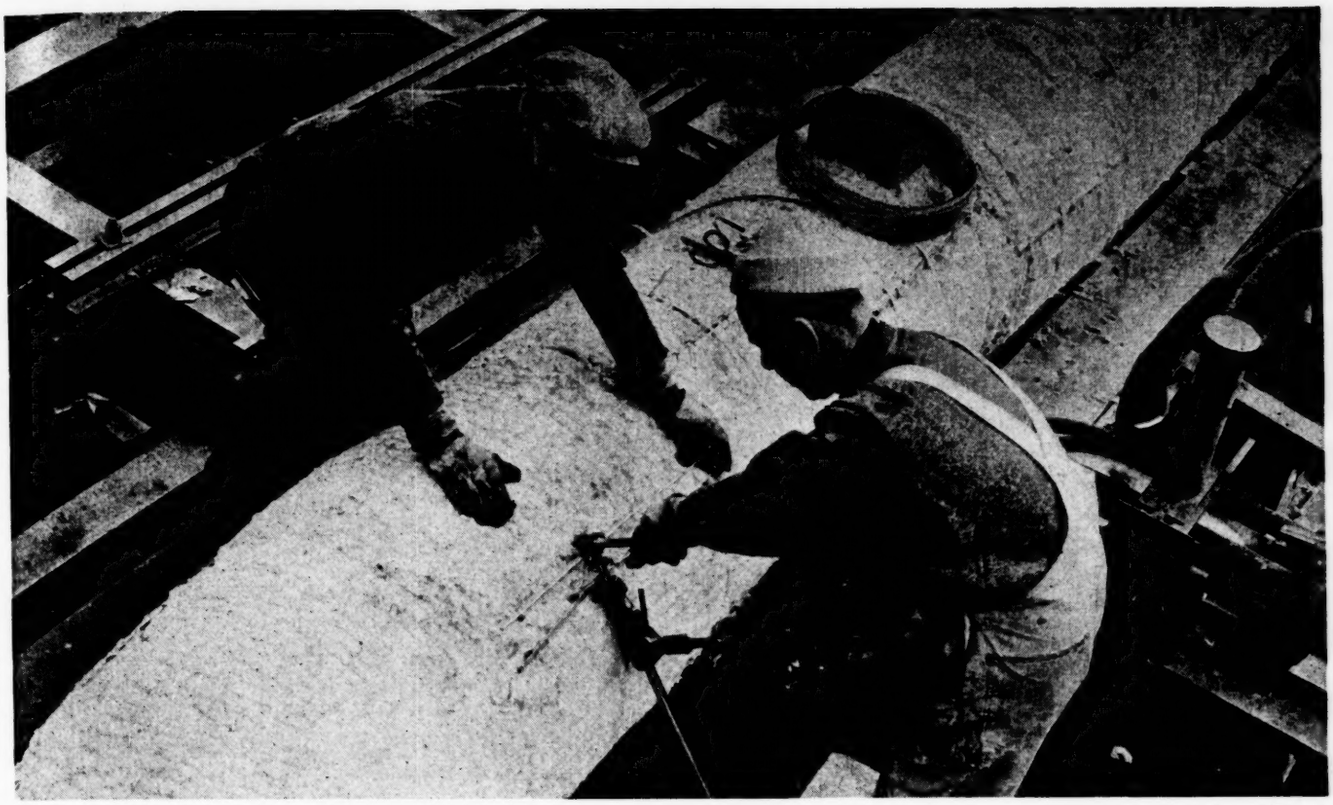
Cooling the Finished Product

The refrigeration engineer has a wonderful opportunity to do an excellent job for the baker. Bread cools very rapidly by evaporation and radiation when it first leaves the oven at 212F, but the real problem has to be faced after the first 45 minutes. During the first 45 minutes, in which time it cools to about 110-115F, the rate of cooling is only very slightly influenced by the surrounding air. From that period on a real job is presented to the refrigeration engineer. To date very little has been done on this problem, but when it is solved the writer believes that it will be largely through dehydration.

So far we have traced the course of a loaf of bread from its start to the finished product on the grocer's shelf. And as we have progressed we have tried to show where and how refrigeration and air conditioning fit into the direct process. There are several indirect points at which refrigeration is required in bakeshops. Cold rooms are needed to preserve perishable ingredients, such as lard, shortening, raisins, yeast.

Lately refrigeration has been employed for retarding the fermentation process for long periods of time. This partly eliminates the baker's guessing several days ahead what his requirements will be.

The baking industry, because of its requirements for close, accurate controlled conditions, was one of the first to receive the benefits of modern air conditioning and refrigeration. It still has with it the same exacting requirements, although better understood. The baker still needs the help of the air conditioning engineer and the refrigeration engineer. He has a real problem and we of the air conditioning field have a real opportunity for service to the bakers.



Blanket-type insulation being applied on a large diameter pipe.

Glass Fibers for Insulation

ALTHOUGH commercially produced since 1930, Fiberglas has so many forms and applications that it merits presentation in this department. It is the third glass product to be described.

The basic form of Fiberglas thermal insulation is a white, resilient blanket, of predetermined thickness, consisting of a mass of intricately interlaced glass fibers. This basic, wool-like form can be fabricated into bats, rolls, bulb fibers, and shredded fibers. The shredded fiber is the bulk fibers chopped into smaller pieces. It can be faced with paper, a fabric or a metal mesh. It can be compressed, treated with a small percentage of thermosetting resin, and fabricated into preformed materials such as sheets or boards, blocks and molded pipe coverings.

The boards can be given a variety of surface treatments, including a sanded, smooth finish on one side, a paper or fabric facing on one side, and an over-all asphalt coating. Predetermined density of the boards ranges from 2.5 to 9 lb per cubic foot. Density of the basic, wool-like form of Fiberglas thermal insulation can be varied by compression over a similar range.

Fiberglas is available in various forms and each, with the maker's designating letters, follows:

TW-F Includes rolls, bats, bulk and shredded forms. It is used in the fabrication of metal mesh blankets, blanket-type insulation, and some forms of sewn blankets.

TM Preformed material made by compressing glass fibers and adding a thermosetting resin.

TFD Most flexible and lightest of the TF material. Weighs less than 3.5 ounces per board foot at an average density of 2.5 lb per cu ft.

PFG Of medium flexibility and weighs 4 1/3 ounces per board foot with an average density of 3.25 lb per cu ft.

PFL Semi-rigid. Weighs 5 2/3 ounces per board foot with an average density of 4.25 lb per cu ft.

PFT Rigid. Weighs 8 ounces per board foot with an average density of 6 lb per cu ft.

OC-9 Rigid. Has a density of 9 lb per cu ft.

The low thermal conductivity of Fiberglas insulating materials is due primarily to the millions of air spaces entrapped by the interlaced fibers. Where the fine, cylindrical fibers cross and touch each other they have exceedingly small contact points so that heat cannot pass readily from one fiber to another.

The material is inherently fire-safe. The small amount of lubricant with which the fibers are treated,

or the small amount of thermosetting resin used to give permanence of dimension, may volatilize at elevated temperatures, but organic facing materials can be flame-proofed. The fibers themselves are completely incombustible.

Fiberglas provides no sustenance for insects or vermin of any kind, and is immune to decay. Properly installed, the materials do not settle down under shock or vibration, leaving gaps for heat loss; rather, unless bonded with a resin, the compressed fibers tend to fluff out filling any voids.

The fibers do not pick up more than a fraction of 1% by weight of moisture from humid air. Water will wet only their surfaces. Insulating wools dry out rapidly after wetting if drained and vented to the air, because the water can only gather in the interstices of the material and is not absorbed within the fibers themselves.

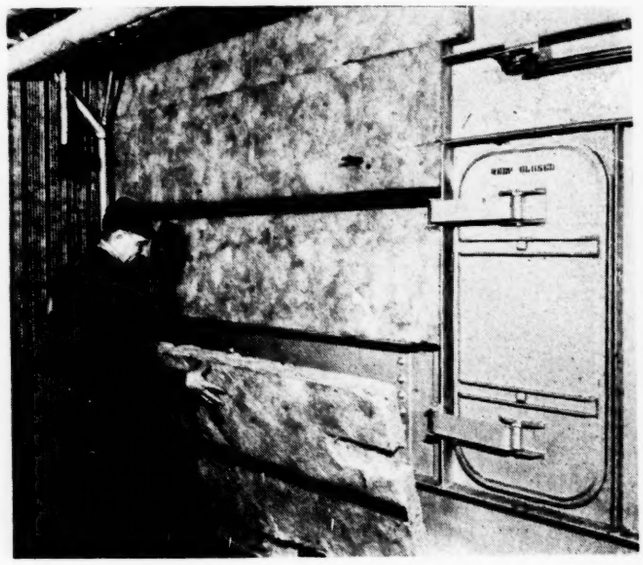
Used for Noise Reduction

The fact that Fiberglas thermal insulating materials are efficient absorbers of sound has led to their wide use for the double purpose of providing a barrier to the passage of heat and reducing noise. When installed immediately behind a perforated surface of metal, asbestos board, hard fiber board or similar material, a noise reduction factor as high as 0.95 may be obtained, the exact figure depending upon the form, thickness and density of the Fiberglas, the type of finish, and the method of installation.

Type TW-F, either in bat, roll, bulk or shredded forms, is suitable for use in all temperatures from sub-zero to approximately 1,000F. Bats and rolls are widely used in stoves, roasters, water heaters, industrial ovens — also for some applications in industrial buildings, railroad cars, ships, buses, and trucks. The bulk form is generally employed as an accessory material for stuffing or packing into odd spaces. Shredded Fiberglas thermal insulation is used wherever pneumatically applied.

The standard size of a bat is 24 x 96 in., and the thickness ranges from ¾ to 3 in. The ¾ in. thick bat comes packed 12 in a carton or 192 sq ft of material, and the thickest comes 3 bats to the carton.

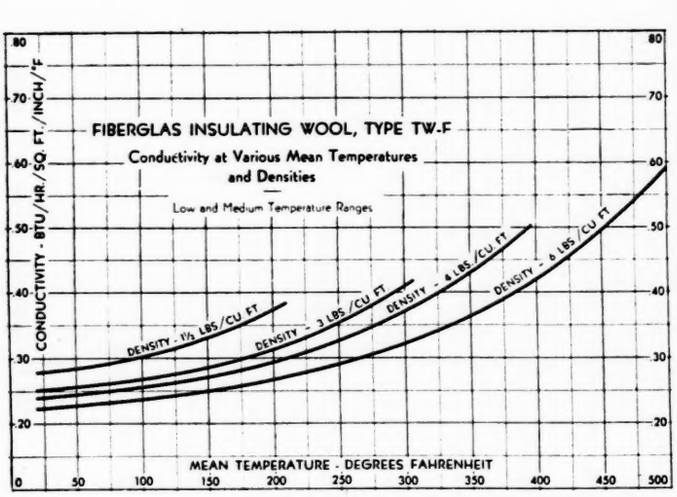
Fiberglas blankets, the basic form of Fiberglas thermal insulation faced with flame-proofed muslin or Kraft paper, are used extensively to insulate refrigerated freight cars, railway passenger cars, trucks, trailers, buses and in tents and buildings

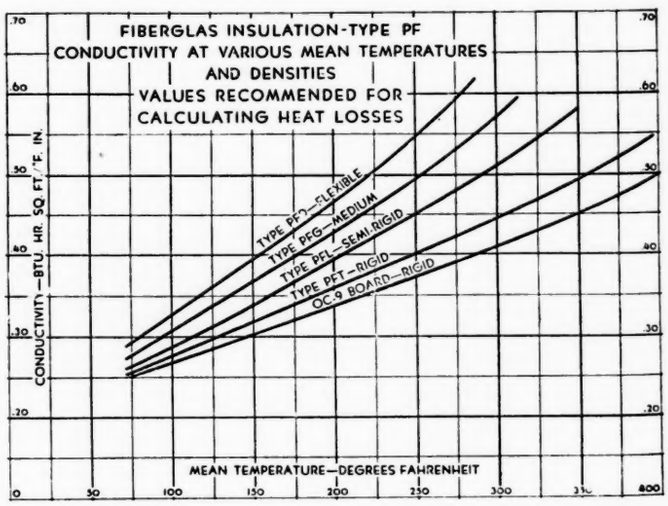


Insulating board being installed on shipboard.

used by the armed forces in Arctic regions. Blankets with a facing of incombustible Fiberglas cloth are used in aircraft to insulate gasoline heater exhausts, heat exchanger ducts, and other high-temperature pipes, tubing, ducts and fittings.

With a metal-mesh facing, the blankets are used for the insulation of heated equipment such as boilers, tanks, industrial ovens, large ducts and breechings. Temperature limits of Fiberglas blankets vary with the facing material used. Temperature limits of the Fiberglas itself are the same as for bats and rolls. Blankets come in thicknesses of ¾ to 4 in.


FIBERGLAS INSULATING WOOL, TYPE TW-F
Conductivity at Various Mean Temperatures and Densities
Low and Medium Temperature Ranges
CONDUCTIVITY - BTU/HR./SQ. FT./INCH/°F
MEAN TEMPERATURE - DEGREES FAHRENHEIT
DENSITY - 1½ LBS/CU FT
DENSITY - 3 LBS/CU FT
DENSITY - 4 LBS/CU FT
DENSITY - 6 LBS/CU FT

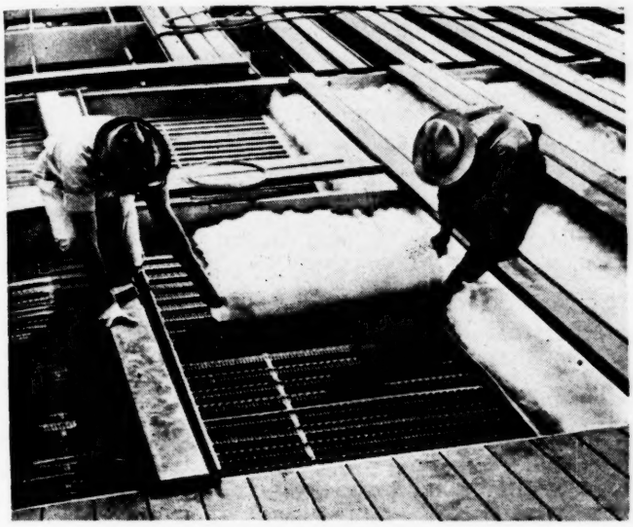


Conductivity curves for several types of Fiberglas insulation.

In acoustical applications, the blankets faced with Fiberglas cloth or flame-proofed muslin find use in radio studios, motion picture sound studios, and as a ceiling in night clubs and restaurants.

Preformed Materials

Fiberglas semi-rigid or rigid sheets or boards, Type PF, can be used in all types of low and medi-



Insulating the roof of an industrial plant.

um temperature equipment up to about 600F maximum. In equipment operating at temperatures above 450F the resin used as a binder disappears from the hot side, leaving a layer of unbonded fibers which fulfills its insulation function with unimpaired efficiency up to 1000F so long as it is enclosed by supporting surfaces.

Sheathed on all sides with a tough, durable asphalt coating, Fiberglas board is widely used in cold storage service, and performs efficiently under conditions of moisture and temperature variations such as exist in refrigerated spaces. An asphalt-enclosed board with a density of 9 lb per cu ft can be used for the insulation of floors and the construction of self-supporting, but not load-bearing, partitions. A 6 lb density, asphalt-enclosed board is made for use only on ceilings, and on walls where the structure carries the whole load.

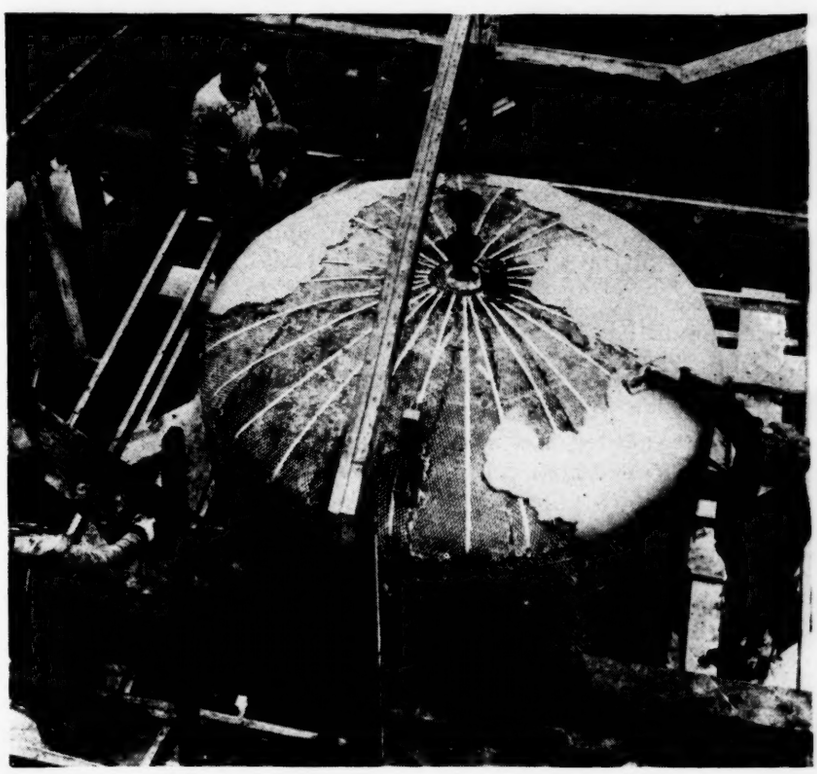
Fiberglas boards accurately molded into cylindrical form provide a convenient means for insulating steam and other pipes in all standard sizes up to 30 in. inclusive, for temperatures up to 600F. A blanket-type insulation, the basic form of Fiberglas thermal insulation with a metal-mesh facing, is employed for insulating pipes up to 1000F in sizes 3 in. and larger.

A high-temperature block is available for insulating boilers, breechings, heated tanks, casings, ducts and other heated process equipment operating at temperatures up to 1800F. There is also a Fiberglas insulating cement which can be used over Fiberglas insulation blocks and blankets to provide a monolithic insulation for pipes, tanks, ovens and other types of heated equipment.

Two types of blocks are available—the No. 600 for temperature limits of 600F and the No. 1800 for temperature limits of 1800F. The former comes in bricks 6 in. x 36 in., and 12 in. x 36 in., with thicknesses of ¾, 1, 1½, and 2 in. The density is 9 lb per sq ft.. The other type comes in three sizes—3 in. x 18 in., 6 in. x 36 in., and 12 in. x 36 in., with thicknesses of 1, 1¼, 1½, and 2 in. The density is 23 lb per cu ft.

A recently developed sheet is 0.5 in. thick weighing only 0.04 lb per square foot, which is used in cabins and flight decks of planes to provide insulation against the extreme cold of the stratosphere and to deaden sound. When subjected to a temperature of 125F, and to 90% relative humidity, the sheets gain less than 1% of their weight from moisture in the air.

Data and illustrations were supplied by the Owens-Corning Fiberglas Corp., makers of the material.



Insulating cement being applied over Fiberglas metal-mesh blankets.

Heating and Ventilating design problems in a

State Hospital for Mental Cases

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TRAVERSE CITY State Hospital is one of several institutions operated by the State of Michigan for the care of mental cases needing hospitalization. It is located at Traverse City, in the heart of the cherry district of Michigan, one of the vacation spots of the country. The original building dates back to 1880, when the hospital was founded under the able supervision of Dr. James Decker Munson. The site chosen is at the foot of some low wooded hills which protect the hospital buildings from the cold northwest and northeast winds.

These same hills have springs which provide the hospital with an adequate gravity supply of good drinking water. Pumping is only required in case of fire.

The hospital has now grown into an institution housing some 2,500 inmates, both men and women, and is headed by Dr. Ralph P. Sheets. The hospital is complete with its own power plant, laundry, bakery, farms, greenhouses, store buildings, occupational buildings and recreational areas.

The state realizes its responsibility for the care of the mentally sick and has an active program for the development of its hospital facilities. As a part of this program, a Receiving Hospital was planned and constructed at the Traverse City State Hospital to house some of the administrative departments until an Administration Building can be constructed. It provides suitable operating room facilities, X-ray rooms, dental offices, etc., and accommodations for the care of those needing hospitalization. This hospital unit has a floor area of approximately 98,000 sq ft on the four main floors, and about 25,000 sq ft of service area on the ground floor. The capacity of the hospital is 250 beds.

Self-contained Hospital

It was the endeavor of hospital authorities and the architects to provide a complete unit having all the facilities needed for a self-contained hospital unit, with the exception of a power plant. There is a receiving suite, social workers' offices, operating suite, dental suite, laboratories, drug dispensary, single bed rooms, wards, day spaces, utility and work rooms, hydrotherapy rooms, pack rooms, kitchen and cafeterias, morgue, chapel, staff library, doctors' offices, visitors' rooms, barber shop, beauty shop, X-ray department, fracture room, etc.

Treatment rooms include irrigation rooms with special tables and fixtures for colonic irrigations; continuous flow tub rooms where patients are given baths in constantly moving water held at a constant temperature; pack rooms with their attendant "quiet" rooms; hydrotherapy rooms complete with showers, sprays, sitz baths, nauheim baths, perineal stools, vapor baths, electric bath cabinets, etc.; electro-therapy rooms, and fever therapy room for the treatment of disease by artificially induced fever.

The operating suite includes a modern arrangement of major operating rooms, minor operating room, anesthesia room, work room, instrument room, utility room, wash-up room, and doctors' and nurses' rest rooms. This section is air conditioned. This suite was especially designed to make it easily kept clean and sanitary. The floors in the operating and anesthesia rooms are of spark proof construction, and the electrical equipment is explosion proof. The sterilizers are recessed to make a flush mounting. Glass block is used in these rooms to eliminate glare and excessive shadows. Both ceiling and portable operating lights are provided.

Special Fixtures Installed

The dental suite and X-ray department require many special plumbing fixtures some of which were designed especially for this installation. For instance the autopsy table is special because of the large number of examinations involving opening the head cavity. Standard units were not suitable.

Barber shops and beauty parlors were provided, because it has been found that there is a very beneficial effect on the mental state of some patients if he or she is well groomed.

Patients in this hospital, with the exception of the disturbed or bed patients are fed in three cafeterias supplied by a central kitchen in the basement. Every effort is made to make their surroundings normal, and, therefore, the patients choose their own food and make up their own table groups. Special lunches and treats are prepared and dispensed on each floor from kitchenettes provided for that purpose.

This building is connected to the Administration Building by an underground tunnel which carries the steam, condensate return, cold water, softened cold water, and hot water piping from the powerhouse and also provides a walking tunnel. This main tunnel connects to the new building in a subbasement in which are located the steam pressure

reducing valves, heating system control valves, flash tank, vacuum pumps, etc., and from which smaller pipe tunnels extend around the outside wall of the building. The riser valves are all located in these pipe tunnels and all major valves are tagged and labeled.

The major part of the mechanical equipment is located in two mechanical equipment rooms and one air conditioning equipment room, located in the basement.

Mechanical Equipment

Equipment in the mechanical equipment rooms consists of the inlet louvers and dampers, preheat coils, air filters, fans, air washers, pumps, reheat coils, air compressor for the zone control apparatus, drinking water cooler, storage tank, and circulating pump, refrigeration equipment for the morgue, and panel for the zone control system. Air filters are of the renewable type using a filter medium especially recommended for this installation because of the Underwriters smoke rating. Across the filters is installed a warning device which whistles when the pressure drop across the filters exceeds the predetermined setting. The preheat and the reheat coils are of the copper fin blast coil design. The air washer is installed as a "blow-through" unit to minimize fan noise or vibration. Fans are double width, double inlet units, operate at relatively slow speeds, and are mounted on vibration bases to reduce noise. For this same reason the ductwork is sized to keep air traveling at low velocities.

The ventilation of the general hospital space is accomplished by supplying fresh air under pressure to the bedrooms, wards, day spaces and other living space, and exhausting the air from the day spaces, toilet rooms, bath and shower rooms and the corridors.

The supply and exhaust grilles are of a plain lattice design with a gravel screen in back of the face to prevent patients throwing foreign material into the ductwork. The grilles are painted to match the walls to make them as unobtrusive as possible. All grilles and panels accessible to the patients have to be of the vandal-proof type, since patients very often have an obsession for taking apart such equipment. Each grille is provided with a key operated valve to control the air volume.

The building exhaust is handled by exhaust fans of the multi-blade design which are located in the top of the stair wells. These fans are all controlled from the main switchboard located in the sub-basement.

Ventilating System for the Kitchen

The kitchen has a separate ventilating system of its own, which exhausts air from the kitchen through openings in the hoods over the kitchen ranges, steamer, and the steam kettles. These hoods are arranged with grease troughs to prevent grease dripping down into the food, and a grease sump is provided at the base of the riser with a steam connection for cleaning the stack. Openings in the hood are adjustable, and the hood and the stack have openings to provide access for cleaning off heavy grease.

The autopsy and morgue has its own exhaust system, separate from the other systems because of the possibility of odor traveling from the morgue and autopsy room through the ductwork into other rooms.

The battery room and the main sub-station is ventilated to maintain suitable temperatures to protect the electrical equipment in this area. A separate exhaust system eliminates the possibility of battery fumes finding their way into other parts of the hospital.

Heating of the building is accomplished partly by the warm ventilating air and partly by convector type heating units. The building is of airplane shape with the "tail" the front of the building. The heating control system is divided into six zones. The large back wing is sectioned into four zones and the central corridor and the front wing into two zones. The control system is pneumatic in operation and is controlled by an outside thermostat over which is superimposed a room thermostat located in a key room. Each zone control can be reset in six steps at the control panel in the basement.

The heating system is operated at a fairly high vacuum to maintain rapid steam circulation and assure better heat distribution. This high vacuum is produced by large air capacity vacuum heating pumps. These pumps can be operated either on float control or on a vacuum control. It has been found that by maintaining the fairly high vacuum, the return lines are kept free of condensate and the entire system operates more evenly, more quietly, and responds to the thermostat more quickly. The returns from the six zones are brought back to the receiver separately.

Heating Units for Rooms

Heating units for the individual rooms and for the day spaces, with the exception of the strong rooms, are copper fin convectors set in a flush removable panel enclosure. This front panel is locked into place with four cylinder locks because the patients remove the usual type of fastening screws. These units are made readily accessible because patients drop pieces of thread, crumbs, and any other material they can into the outlet grille openings, and of course all this stuff must be cleaned out periodically. The inlet arch at the bottom of the panel is of standard design. So that patients cannot tamper with the units, metal baffles are installed as a part of the mounting bracket for the units, effectively shutting off the space above the inlet arch. In addition to the zone control, each heating unit is provided with a fully packless radiator valve to provide a means of adjusting the room temperature of the various rooms to the individual needs. These valves are installed in back of the removable panel and are not accessible to the patients.

Variable speed unit heaters, thermostatically controlled, are used in the kitchen and diet kitchen for heating this large space.

The heating and ventilating of the strong rooms in which the disturbed patients are housed present special problems. This type patient is very difficult to handle and is entirely unpredictable. Their rooms have to be thoroughly flushed out several times a day, and a hose is kept in a cabinet in the corridor adjacent to these rooms for this purpose. Rooms are made with salt glazed tile walls, terrazzo floors and cove base, and exposed slab and beams at the ceiling. Special lighting fixtures are used which are practically indestructible. Every care is taken to design the room and fixtures so that there is little possibility of the patient injuring himself.

The window to the room is set in a small alcove formed by the furring around the ventilating pipes carried up to these rooms adjacent to the windows. This small alcove is separated from the balance of the room by a vandal-proof screen door set into the masonry. In this way the patient is restrained from getting at the heating units, the ventilating grilles and pipes, and from the window and glass. The ventilating grilles, both supply and exhaust, are set to open in this alcove and the supply grille is set to throw the fresh air into the room proper.

Being set in the wall of the alcove, the patient cannot throw soil or other material into the ventilating system. The heating unit is a hospital type wall radiator, and is controlled in the same manner as the heating units in the balance of the building. This heating unit is set on the face of the wall unenclosed so that the unit can be flushed off at the same time the balance of the room is hosed down.

Air Conditioned Operating Rooms

The entire operating suite is air conditioned. These rooms received special consideration because of the trend toward the use of anesthesias having very definite explosive tendencies when the humidity is not kept within the proper range, and also to help reduce the shock to the patient undergoing the operation, and to produce better operating conditions for the doctors. Although the operating rooms are equipped with large central ceiling operating lights, the doctors generally use the portable operating room lights because they are more adjustable and give a light better suited for operations. These lights are placed as close to the working area as possible and quite often this means the light is almost burning the neck, shoulder, or face of the operating doctor. Often more than one of these lights are used, and the heat causes a good deal of discomfort in the usual operating room. Air conditioning goes a good way toward correcting this condition.

Air from these rooms is not recirculated because of the possibility of a build-up of anesthesia vapors. All equipment for the air conditioning system is located in the basement in the air conditioning equipment room while the operating rooms are on the second floor. To conserve space, because this equipment room is in a rather important and somewhat congested area, the air conditioning equipment is double decked. It operates with an air filter, air washer, cooling coils, preheat and reheat coils and supply fan.

The normal temperature of this section of the building is maintained in the winter time by hospital type heating units controlled by thermostatic valves.

Provisions have been made in the air conditioning system for the installation of germicidal lamps at some future time.

Steam Used for Food Processing

Besides heating the building, steam is used for processing food in the kitchen, for distilling water for use in the drug department and the laboratories, for sterilizing water and instruments, for operating the autoclaves, for the vapor baths, blanket driers and warmers in the hydrotherapy and pack rooms, and in the bedpan washer and sterilizers. All of this equipment operates at a pressure much higher than the heating system and where condensate is returned, it is returned to a flash tank in the basement which is connected into the heating system. Any excess steam is killed by a thermostatically operated water spray located in the flash tank. In addition, the tank is vented to the atmosphere.

Vapor Baths

Vapor baths are an interesting feature and are perhaps not too generally known. The baths occupy a small room opening from the hydrotherapy room and this room is just large enough for the table on which the patient lies and a small space for the attendant. The room is constructed of materials not affected by moisture. In operation, the patient lies on the table with his body in the vapor bath room and his head extending into the hydrotherapy room. Close fitting doors close over his neck and seal the vapor bath room from the large room. Steam is then turned into the vapor spray pipe and soon fills the room. The temperature of the room is controlled from the hydrotherapy room by the attendant. This temperature is indicated on a thermometer extending from the vapor room.

After the steaming operation, the attendant enters the smaller room and massages the patient or bathes him, depending upon the treatment outlined. The table is actually a marble slab which is kept at a suitable temperature by a steam coil controlled by a thermostatic valve, the control bulb of which is set in a hole in the side of the slab. The vapor pipe is located below the slab and is separated from the slab by a protecting hood which deflects the steam.

The equipment was manufactured by the following firms: Heating units and specialties, The Trane Co.; vacuum pumps, Nash Pump Co.; air filters, American Air Filter Corp.; zone control equipment, Johnson Service Co. The plumbing, heating and ventilating contractor was N. J. Yonker & Sons, and the general contractor, Christman Lansing Co.

The Welding of Process Piping

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Part 2

THE next major division of the chart (Fig. 1) deals with copper and copper base alloys (Box 2-2) and their joining to other metals. Actually this and all the other principal groupings of this chart could be greatly amplified in order to cover adequately the ramifications of the various alloys. For example, copper base alloys could be broken down into several subdivisions representing the different types of alloys. However, if such a detailed breakdown were employed, Fig. 1 would become a chart several feet long. One actual limited analysis of this general subject produced a chart six feet long. It should be obvious, therefore, that the present condensed listing is necessary to keep this within the requirements for publication.

When joining this → to this ↓	STEEL, WROUGHT IRON, AND GALV. IRON	COPPER AND COPPER BASE ALLOYS	STAINLESS STEELS	NICKEL AND NICKEL ALLOYS	ALUMINUM AND ALUMINUM ALLOYS	CAST IRON
STEEL, WROUGHT IRON, AND GALV IRON	Metal arc welding Oxyacetylene welding Braze welding Brazing 1-1					
COPPER AND COPPER BASE ALLOYS	Braze welding Brazing Metal arc welding 1-2	Oxyacetylene welding Braze welding Brazing Carbon arc welding Metal arc welding 2-2				
STAINLESS STEELS	Metal arc welding Oxyacetylene welding Brazing Braze welding 1-3	Brazing Braze welding 2-3	Metal arc welding Oxyacetylene welding Brazing Gas shielded arc welding Braze welding 3-3			
NICKEL AND NICKEL ALLOYS	Brazing Metal arc welding Oxyacetylene welding Braze welding 1-4	Brazing Braze welding 2-4	Metal arc welding Oxyacetylene welding Brazing Braze welding 3-4	Metal arc welding Oxyacetylene welding Brazing Carbon arc welding Gas shielded arc welding Braze welding 4-4		
ALUMINUM AND ALUMINUM ALLOYS	Not a practical welding or brazing operation at the present time 1-5	Not a practical welding or brazing operation at the present time 2-5	Not a practical welding or brazing operation at the present time 3-5	Not a practical welding or brazing operation at the present time 4-5	Oxyacetylene welding Metal arc welding Gas shielded arc welding Brazing Carbon arc welding 5-5	
CAST IRON	Braze welding Brazing Metal arc welding 1-6	Braze welding Brazing 2-6	Brazing Braze welding 3-6	Brazing Braze welding 4-6	Not a practical welding or brazing operation at the present time 5-6	Oxyacetylene welding Metal arc welding Braze welding Brazing 6-6

Fig. 1. How to join one metal with another. Shaded part indicates the methods discussed in this article.

Fortunately in the present problem, the limitation of piping material eliminates certain of the copper base alloys since these are not generally available in pipe or tubing. In view of this, only the following metals will be considered; electrolytic or tough pitch copper, deoxidized copper, yellow brass, red brass, and copper-silicon alloys.

Influence of Lead on Welding

One important point must be remembered in welding copper base metals containing lead. No definite limits have been set for lead content but experience seems to indicate about 0.5% to be tolerable and certainly 1% would be a maximum. The best success in welding alloys with higher lead concentrations has been obtained with carbon arc welding; this is, however, subject to the limitation that welding by this method can be done in the flat position only. According to the Welding Handbook,[5] "Lead gives trouble in the oxyacetylene fusion or bronze welding of brass castings by sweating to the surface at temperatures not greatly above its melting point, 620° F (327° C). It oxidizes at higher temperatures and the unstable oxide interferes with the welding operation. However, by the use of an *oxidizing flame*, which stabilizes the oxide, and plenty of *brazing flux, trouble from this constituent is minimized.*"

Notwithstanding this, it has been the writer's experience that lead in the range of 5-15% renders a brass virtually unweldable. Particularly in castings such as fittings this element causes difficulties. Even if care is exercised to deposit sound weld metal under these conditions, it will be found that while no leaks occur in the weld, adjacent thereto so much lead has been sweated out that the casting is porous.

An excellent discussion of the welding, brazing and braze welding of copper and its alloys will be found in the Welding Handbook, Chapter 22[6]. While not specifically covering pipe, it does provide ample data on the various compositions to permit accurate decisions for many applications.

Since copper and most of its alloys possess very high heat conductivity, more heat is required for welding than would be necessary for the same thicknesses of steel. For thinner sections and small assemblies, the required amount of heat may be secured by using larger tips for oxyacetylene welding, or higher currents for arc welding. On heavy sections and parts of appreciable mass, separate preheating is essential for any process. This preheating may be secured by extra oxyacetylene torches, gas-air torches, air-oil burners or, if necessary, charcoal fires. Preheating to 400-600F minimum should be employed, and sometimes higher. To conserve this preheat and at the same time protect the operators, the assembly should be covered with asbestos paper.

[5]Welding Handbook — American Welding Society, 1942, page 872.
[6]Welding Handbook — American Welding Society, 1942, pages 852-884.

Welding Copper to Copper

Considering now the welding of copper and copper base alloys, the order of listing of the processes in box 2-2 (Fig. 1) has been largely dictated by the fact that it is necessary to weld pipe in all the positions shown in Fig. 2 (page 59, February, 1945). For this reason carbon arc and metal arc welding rate only fourth and fifth, respectively, since neither is suitable for all-position welding. It is to be admitted that where welding is performed in the flat position only, carbon arc welding has certain advantages. These details are covered under the discussions of the several types of coppers and alloys to be considered here since it will be necessary to deal with each type separately.

Commercially pure copper is available in three common forms: electrolytic, deoxidized, and oxygen-free. The first is also known as tough pitch or Lake copper. Electrolytic copper is the form most generally available and consists of 99.93-99.97% copper plus 0.03-0.07% oxygen present as cuprous oxide. Deoxidized copper, as the name implies, has the cuprous oxide completely removed. It exhibits the following typical analysis: 0-0.05 phosphorus or 0-0.10 silicon with the balance copper. Oxygen-free copper is produced by a special process which results in copper free from oxide.

The cuprous oxide present in electrolytic copper is helpful in reducing the grain size but detrimental to producing welds of strength equal to the unwelded copper. The reason for this is that the cuprous oxide renders the copper susceptible to gas embrittlement when heated to temperatures of 1300F or over in atmospheres of hydrogen or carbon monoxide. Two phenomena are believed to operate, one causing a segregation of cuprous oxide at the grain boundaries, the other causing a reduction of the oxide by the hydrogen. The result of this action is to leave the welded unit with tensile strengths as low as 12,000 lb per sq in. as compared to 32,000 lb per sq in., the strength of soft copper.

Deoxidized copper is not subject to these difficulties, hence should be selected for piping to be welded.

Electrolytic Copper

Electrolytic copper may be welded, preferably with the carbon arc procedure, using a phosphor bronze filler rod or a copper silicon alloy rod. Similarly, phosphor bronze or aluminum bronze (Analysis II) shielded arc electrodes may be used for metal arc welding. Since the atmosphere of the metal and carbon arcs have practically no hydrogen present, the phenomenon described previously will be less operative in weakening the weld. High welding speeds are imperative to minimize segregation of the copper oxide.

Electrolytic copper may be brazed with low temperature brazing alloys since lower temperatures and shorter times are involved. A lap type joint is required. The silver-phosphorus-copper and the phosphorus-copper low temperature brazing alloys are completely satisfactory for this work. In addi-

tion, the silver-copper-cadmium-zinc silver brazing alloy may prove advantageous due to its lower melting temperature. While brazing fluxes may be omitted with alloys containing phosphorus, still it is a wise precaution to employ flux and thus insure a sound joint.

Oxyacetylene welding and braze welding of electrolytic copper had best be ruled out for reasons described earlier. However, where the lower strength is acceptable, welding may be performed with a deoxidized copper rod and a suitable flux such as is used for braze welding. Similarly, braze welding may also be employed using flux and copper-zinc rods of Analyses I, III or IV, previously listed.

Deoxidized copper piping or tubing is best welded with the oxyacetylene process since it may be handled in all positions and deoxidized copper welding rods are commercially available. Another welding rod which appears to offer possibilities in this class of work is one containing 98.5% copper with about 1.0% silver and 0.5% phosphorus. Its melting point is lower than copper but still within the range producing a fusion weld. The only disadvantage is a somewhat higher cost because of the silver content. Fluxes are necessary for welding deoxidized copper, the type employed in braze welding generally proving satisfactory.

Obviously, deoxidized copper may be successfully braze welded since it is not subject to difficulties from cuprous oxide. Any of the 60% copper, 40% zinc rods as represented by Analyses I, III or IV may be used. A suitable braze welding flux must be used.

Brazing with the silver brazing alloys may also be employed for joining deoxidized copper. Again, while flux may be omitted with those brazing alloys containing phosphorus, it is better to use a suitable flux.

Carbon arc welding is also suitable for welding deoxidized copper although it is limited to work in the flat position. A phosphor bronze or silicon bronze rod is recommended. A flux of borax and sodium fluoride (90% and 10%, respectively) is sometimes helpful. (NOTE: Since this flux contains fluoride, adequate ventilation of the welding operation is necessary.)

Metal arc welding with shielded arc electrodes of the phosphor bronze or aluminum bronze analyses is also suitable.

The discussion of this group, up to this point has been limited to commercially pure copper because of the peculiar difficulties involved. Similarly, alloys of copper must be treated individually since they present different problems depending upon the extent and nature of the alloying ingredients.

In these copper alloys, those referred to as yellow and red brasses are not too clearly defined for the reason that several alloys are known by each of these designations. For example, an alloy of 85% copper, 5% tin, 5% zinc and 5% lead is called red brass, as is also one of 85% copper and 15% zinc. Obviously the former analysis would exhibit limited weldability for pipe material, for reasons previously given, while the latter composition would be readily

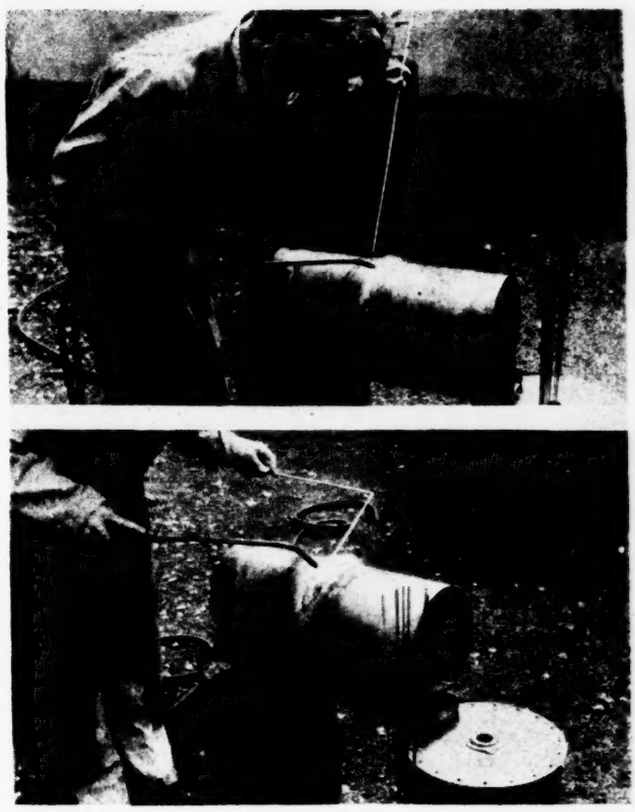

Fig. 2. Upper, tacking red brass pipe. Lower, making a rolling weld on a horizontal length of red brass pipe.

weldable. Again, fortunately the limitation of piping material rules out many of these variations and the two most common analyses encountered are 60% copper and 40% zinc for yellow brass and the 85% copper and 15% zinc for red brass.

Oxyacetylene welding is the preferred method for welding both of these brass compositions since it is usable in all positions. Metal arc welding, with filler metal of the same analysis, at the present time is not suited to this operation for the reason that the zinc, one of the major constituents of both alloys, melts at 787F and vaporizes at 1706F, well below the temperatures existing in the arc. This high temperature leads to a burning out of the zinc and results in porous welds. Metal arc welding with aluminum bronze electrodes (Analysis II) and carbon arc welding with silicon copper rods may be used but operations are limited to the flat position. Low temperature brazing is also successfully used on these metals.

For the oxyacetylene welding of yellow brass any of the braze welding rods, Analyses I, III or IV, may be used. However this operation is not one of braze welding but rather true fusion welding since both base metal and filler metal melt at approximately the same point. Standard joint designs suitable for other welding techniques are applicable to this alloy. A flux is essential to success and since the standard braze welding rods are used, braze welding fluxes are also acceptable. The flux should be capable of controlling the volatilization of the zinc to insure sound welds.

For brazing of yellow brass pipes, any brazing alloys may be used with the lap type joints. A suit-

able low temperature brazing flux must also be used. In addition there are available fittings of cast brass into which, at manufacture, is placed a ring of the copper-silver-phosphorus alloy. This ring is within a groove to permit insertion of the pipe. After cleaning, fluxing and assembling pipe and fittings, heat from an oxyacetylene torch is applied to the fitting and pipe causing the alloy to melt and fill the annular space.

Red brass pipe is oxyacetylene welded using either the braze welding rods listed before for yellow brass or a silicon bronze rod of the following analysis:

Analysis V	
Copper	97.5%
Silicon	1.5
Zinc	1.0

Red brass is frequently used in corrosive service because of its low zinc content, particularly in those cases where the fluid content exhibits a tendency to attack the zinc—commonly called dezincification. Obviously under these conditions the high-zinc braze welding rods should be avoided as weld metal, and in their place the silicon bronze should be employed.[7,8] Fluxes as described for yellow brass are necessary in this case also. For low temperature brazing of red brass the same comments provided under yellow brass apply, including the special type of fittings described.

The copper-silicon alloy is welded with rods of the same analysis as given (Analysis V) using either the oxyacetylene or carbon arc techniques. Obviously for all position welding the oxyacetylene procedure should be employed. For oxyacetylene welding, a good braze welding flux is requisite. For carbon arc welding it is recommended to use a flux consisting of 90% fused borax and 10% sodium fluoride in alcohol. (CAUTION: Since this flux contains fluoride it must be used only where adequate ventilation is provided; the operator should take special care to avoid contact of the flux with the mouth or eyes.) Low temperature brazing may be employed for joining this alloy. Any of the brazing alloys listed previously, together with proper flux and the lap type joint, will prove satisfactory.

So far, in considering the problems presented by box 2-2 (Fig. 1), only the welding of like metals to themselves has been dealt with. However, since many of these alloys have appreciably different melting points, difficulties will be encountered when welding of combinations is attempted. Of course braze welding and low temperature brazing will provide solutions to many of the problems. For assemblies of copper and red brass or copper and silicon-copper alloy, the use of silicon-copper welding rods will yield the best results. Either oxyacetylene or carbon arc welding may be employed.

Progressing to the next box on Fig. 1, namely 2-3, it will be found that but two processes are listed. The reason for this is simply that the melting temperatures of the two types of metals are so far apart that none of the fusion welding procedures can be applied; therefore it becomes necessary to resort to the lower temperature joining methods. Since one of the metals to be joined in this group is a ferrous base alloy it is necessary to use the silver brazing alloy consisting of silver, cadmium, copper and zinc. The other low temperature brazing alloys of the silver-copper-phosphorus or the copper phosphorus types cannot be used on ferrous metals or alloys. The use of an appropriate low-melting-point flux together with the lap type joint will insure success on these joints. Since the heat conductivity of copper and its alloys is greater than that of stainless steel, it will be necessary to provide some form of supplemental heating for the copper to insure that it will reach the melting point of the alloy at the same time as the stainless steel.

Braze welding may also be used for joining copper and its alloys to stainless steel, as indicated in box 2-3. While any of the braze welding rods could be used, it would probably be best to employ only the manganese bronze type (Analysis III) or the low fuming type (Analysis IV) because of the higher strength and ductility. A suitable braze welding flux must be employed.

The joining of nickel and nickel alloys to copper and copper alloys (box 2-4) is best accomplished with brazing and braze welding for the metals under consideration here. In brazing, best results will be obtained if the silver-cadmium-copper-zinc alloy, appropriate low melting point flux, and the lap type joint are used. The other low temperature brazing alloys are not suited for this class of work. Braze welding with any of the standard rods and fluxes, while possible applications, are best reserved for emergency repairs.

Box 2-5 would normally cover the joining of aluminum and its alloys to copper and its alloys. Due to the differences in melting points the joining of these metals by a welding or brazing process is, for the present, considered impractical.

Connections of copper base metals to cast iron as covered by box 2-6 are best made with either the braze welding process or brazing. There is really no preference for either method, and therefore the job conditions may be relied upon to indicate which to use. For braze welding any of the standard rods will prove satisfactory. A suitable braze welding flux is necessary. In addition, with some grades of dirty cast iron it may be necessary to provide a separate flux to promote the bonding or tinning action. In low temperature brazing it will be necessary to use the silver-cadmium-copper-zinc alloy since cast iron is a ferrous metal. A low temperature brazing flux is essential. Due to the greater heat conductivity of copper, it may be necessary to preheat the part of that metal to insure a sound joint. Care must also be exercised in braze welding or brazing on cast iron, so as not to cause cracking with the locally applied heat. In critical assemblies the lower operating temperature of silver alloy brazing may offer a means of avoiding this difficulty.

(To be continued)

[7]Kugler, A. N.: Oxyacetylene Welding Red Brass Pipe. The Welding Journal, October, 1939, pp. 622-625.

[8]Vreeland, J. J., and Babin, J.: Welding and Red Brass. The Welding Journal, April, 1941, pp. 219-225.

Solvent Vapors and Their Control

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The war has produced a number of changes which have increased tremendously the problems pertaining to the control of health hazards from solvent, thinner, and cleaner vapors. Recent increase in the number of poisonings in certain industries has emphasized these changes and has indicated that the measures for control have not kept pace with the problems arising from the changing conditions. The author discusses five methods for reducing the solvent vapor hazard, with particular attention to ventilation, and takes up vapor control methods for specific applications to degreasing, cleaning, and finishing.

USE of solvents of all kinds was widespread even before the war and the rate of consumption has increased in line with the expansion and acceleration of industrial activity. Consequently, the number of workers exposed to solvent vapors has increased enormously and in many instances the degree of exposure has increased as a result of the speed-up in activity. Not only has the rate of production per worker increased but the concentration of workers has also been raised, so that the vapor concentrations at similar operations have, in many instances, sharply increased.

A second change which has accentuated the control problem is the substitution of less critical, and frequently more toxic, ingredients in trade name solvent products. Scarcity of some materials and prohibitive cost of others as a result of the war have forced some manufacturers to change the composition of their solvents, thinners, or cleaners. Furthermore, some of the trade name solvent products are not mixtures of basic solvents only, but contain also other trade name solvents as ingredients. Even though such changes are made in good faith by the manufacturers, it has resulted in serious complications. For instance, some solvents and thinners furnished on Federal specifications which limit the proportion of specific toxic materials have been found by analysis to contain high percentages of very toxic chemicals, such as benzol and carbon tetrachloride. Likewise, other solvents which have been marketed without appropriate labels have been found upon analysis to contain much higher percentages of very toxic chemicals than agreed upon between the U. S. Public Health Service and the Manufacturing Chemists' Association. How these toxic materials have crept into products which were previously relatively non-toxic is not known nor is it the intent of this discussion to censure some of the solvent manufacturers. It is merely a statement of fact which must be faced if the hazards resulting from these conditions are to be controlled adequately.

Add to the foregoing problems those brought about by the high percentage of inexperienced and formerly non-industrial workers who do not have the skill of experienced workers in safe and healthful conduct of their operations, and the result is a fair picture of the problems facing industry today in the safe use of solvents.

Control Measures

Poisoning of workers by solvent vapors may be prevented by:

(1) Use of relatively non-toxic solvents, thinners, and cleaners;
(2) Use of relatively non-volatile solvents, thinners, and cleaners;
(3) Isolation or segregation of the operations;
(4) Appropriate respirators;
(5) Ventilation
    General
    Local Exhaust.

All the foregoing measures should be given consideration by management and engineering and medical departments before deciding how best to control the health hazards associated with use of solvents, thinners, and cleaners at specific operations. To arrive at an appropriate decision, it is imperative that the advantages and limitations of the several methods be appreciated fully; therefore, these items deserve some elaboration.

Use of Non-Toxic Substances

One of the most important, and incidentally one of the least expensive, methods for controlling or decreasing the health hazards associated with solvents is the use of relatively non-toxic substances; see Table 1 for a list of some of the more common solvents and their relative toxicities. However, this method is, as a rule, far from foolproof and to be effective requires constant and close supervision. As mentioned earlier, the composition of trade-name solvents may change without notice, so that it is necessary to analyze a sample from each shipment

TABLE 1.—APPROXIMATE MAXIMUM ALLOWABLE CONCENTRATIONS OF SOME COMMON SOLVENTS

Substance	Maximum Allowable Atmospheric Concentration, ppm*
Acetone	400 to 500
Amyl acetate	400
Amyl alcohol	400
Benzene (benzol)	50 to 100
Butyl acetate	400
Butyl alcohol	200
Carbon disulfide	20
Carbon tetrachloride	50 to 100
Dichloroethylene	100
Ethyl acetate	400
Ethyl alcohol	500 to 1000
Ethylene dichloride	100
Gasoline (benzine)	1000
Hexanone	150 to 200
Methyl acetate	400
Methyl alcohol	200
Naphtha (petroleum)	1000
Propyl acetate	400
Tetrachloroethane	10
Tetrachloroethylene (perchloroethylene)	200
Toluene (toluol)	200
Trichloroethylene	200
Turpentine	200
Xylene (xylol)	200

*On basis of 8 hr daily exposure—in parts of substance per million parts of air by volume.

to be certain that the ingredients remain essentially the same and in the same proportion. Also great care must be exercised to prevent changes in the conditions of use, and to avoid all possibility that a more toxic solvent may be obtained by mistake by the none-too-well informed new or inexperienced worker.

Even though it is fundamental that relatively non-toxic materials should be employed insofar as practicable it is frequently preferable and no more hazardous to employ the best solvent obtainable for the job at hand and to control the health hazard by more foolproof methods. If this is done, little danger will arise, in most instances, if the operation is speeded up considerably, if a comparatively toxic solvent is brought from the stock room by mistake, or if a new shipment of the solvent happens to be more toxic than the one used previously. This does not mean that the less toxic substances cannot be used safely without special ventilation or respirators if the necessary precautions are observed. However, toxic materials and changes in conditions of operation have a way of creeping in unbeknown to the appropriate supervisory personnel until some of the exposed workers become ill and report to the dispensary.

Use of Non-Volatile Substances

For those operations where the rate of drying is not important, a satisfactory solvent with a relatively low vapor pressure should be used; see Table 2 for a list of common solvents and their relative volatilities. The slower rate of evaporation (lower volatility) will, in most instances, result in lower concentrations of the solvent vapors in the atmosphere. For example, it is preferable, where practicable, to use tetrachloroethylene rather than trichloroethylene even though the toxicity of both is of the same order of magnitude. This is due to the fact that the tetrachloroethylene evaporates less rapidly than trichloroethylene and consequently produces a lower concentration of the vapor in the air.

On the other hand, this principle must not be depended upon blindly. For example, on a production line where the drying is accomplished in a given area by heating or air circulation nothing will be gained by using the relatively non-volatile solvent, since the same amount of solvent is vaporized per unit time irrespective of the volatility—within limits.

Furthermore, the possible change in composition of the solvent without notice, the possible change in conditions of use without notice, or the possibility of getting the wrong solvent from the stock room are ever present. Either one of these possibilities can result in serious consequences if too much reliance is placed on the volatility factor.

Isolation or Segregation of Operations

This principle finds only limited use in the safe handling of solvents since it is fundamental that the potential health hazard be controlled at its origin rather than to permit the hazard to arise and then attempt to control it. On the other hand it is a very effective control measure for those operations which do not permit convenient control at the source. For example, it is impracticable to control at their sources the solvent vapor and mist produced in spray painting large bulky objects, and in maintenance or repair spray painting. Such operations should be isolated to prevent exposing other nearby workers and the painter should be protected by means of a suitable respirator. Thus in automotive equipment maintenance shops a separate room should be provided for all painting operations to protect the other workers in the shop. The same principle should be applied, if possible, to building maintenance—the interior finishing should be done when the space is not occupied by workers.

Appropriate Respirators

Since it is fundamental that the hazards be controlled at their origin use of respirators is very limited. Furthermore, the wearing of respirators for long periods produces considerable discomfort to the wearers and, consequently, they are usually not satisfactory for continued use. On the other hand, such devices are satisfactory for intermittent exposures to excessive vapor concentrations such as exist during maintenance spray painting of automotive equipment, type cleaning and cleaning of machines or equipment, and even for production spray painting of large bulky objects. Only Bureau of Mines approved respirators of the appropriate types should be used, if available.[1] At present no chemical cartridge type respirators are approved, since no approval schedule has yet been promulgated by the Bureau of Mines.

[1]See Bureau of Mines Information Circulars 7236 and 7237, titled "Selection, Use, and Maintenance of Respiratory Devices," and "List of Respiratory Devices Approved by the Bureau of Mines," respectively.

Such schedule is now under consideration and it should not be long until some of the chemical cartridge respirators now on the market will receive approval for relatively mild exposures to organic vapors (probably not to exceed 0.1%, — i.e. 1000 ppm). Approved gas masks are satisfactory for vapor concentrations of 2% but find very limited application. Approved supplied-air (air-line) respirators are recommended for spray painting operations except when done in properly ventilated paint booths, and suitable chemical cartridge respirators afford adequate protection for many intermittent (maintenance) cleaning operations where the period of exposure is very short.

Ventilation

Vapor control may be accomplished by proper ventilation which may be of two distinct types: (1) general or dilution ventilation; (2) local exhaust or process ventilation. Even though both these control measures are classed under the same general heading they are distinctly different in method of operation. General or dilution ventilation acts by diluting the contaminated air sufficiently with relatively clean air to render the air breathed by the workers harmless, that is, the vapor concentration below the maximum allowable concentration. Local exhaust or process ventilation, on the other hand, acts by preventing the highly contaminated air from escaping into the general work room air.

Since the principle of operation of these control measures is different they will be discussed separately.

General Ventilation. This control measure is in effect at all times to a greater or lesser extent except in air tight spaces. Air enters and escapes from all rooms and buildings through doors, windows or window cracks, and all other openings, and is kept in circulation by temperature differences and by movement of the occupants and equipment in the room. General ventilation may consist of natural ventilation or mechanical ventilation depending upon whether air is caused to move within and through the space by an artificial means such as fans or naturally by gravity exhaust ducts.

General ventilation is very useful and effective, as a rule, for controlling the vapors liberated at scattered and minor sources as differentiated from specific and major sources or origin. Effectiveness of general ventilation can be augmented a great deal by producing a high degree of circulation within the room. Spot blowing at or toward minor sources of contamination and away from the operators aids general ventilation tremendously since, to be effective, the dilution of the contaminated air to a harmless level must be accomplished before it reaches the breathing zone of any worker. If good circulation is not accomplished within the room an excessive ventilation rate will be required to control the exposures adequately, resulting in a very inefficient system and unnecessary heat loss in cold weather.

The quantity of air needed to dilute a solvent vapor to a harmless level (that is, below the maximum allowable concentration) may be computed

TABLE 2.—SOME COMMON SOLVENTS AND THEIR RELATIVE VOLATILITY

(Volatility increases as the volatility index increases)

Substance	Volatility index
Acetone	21
Amyl acetate	4
Amyl alcohol	2
Benzene (benzol)	13
Butyl acetate	7
Butyl alcohol	9
Carbon disulfide	23
Carbon tetrachloride	16
Chloroform	17
Dichloroethylene	22
Ethyl acetate	15
Ethyl alcohol	14
Ethylene dichloride	12
Ethyl ether	24
Methyl acetate	20
Methyl alcohol	18
Methyl ethyl ether	25
Naphtha (petroleum)	19
Propyl acetate	10
Tetrachloroethane	3
Tetrachloroethylene (perchloroethylene)	6
Toluene (toluol)	8
Trichloroethylene	11
Turpentine	1
Xylene (xylol)	5

readily if the rate of solvent consumption in the room is known. Such information can be obtained frequently from the stock room or it can be determined by the room supervisory personnel. If rapid dilution of the contaminated air between its source and the breathing zone of the worker is accomplished by good air circulation within the room the required minimum quantity of air for a given room or space may be computed by means of the following equation:

$$Q = \frac{0.81 \times 10^6 \times S}{xy}$$

where Q = ventilation rate, cubic feet per minute;
S = rate of solvent consumption, pounds per 8-hour day;
x = molecular weight of solvent; and
y = maximum allowable concentration of solvent (see Table 1).

Since complete dilution of the contaminated air is usually not obtained before it reaches the breathing zone of the nearby worker, the ventilation rate must be increased accordingly. How much to increase it can be determined only by a careful study of all the factors involved such as circulation rate, distance of worker from source of vapor, importance of heat loss, number of workers affected, and the like. It may be as little as twice that given by the equation and should never exceed five times that quantity.

No specific rules can be laid down for the type of general ventilation to be employed, that is, whether supply or exhaust. Each problem must be considered individually to obtain the best arrangement. However, the following considerations will serve as a guide in arriving at a satisfactory solution:

(a) The exhausted air must be replaced, either by a supply system or by providing easy entrance for the make-up air;

(b) Short circuiting of exhausted air must be prevented;

(c) If a slight negative pressure exists within the space, cold drafts near doors and windows must be prevented;

(d) Better dilution and lower operator exposure can be accomplished with proper supply than with exhaust since the supply air can be directed toward the important sources of contamination and good circulation is effected without accessory equipment;

(e) A combined supply and exhaust system is preferred with a slight excess of exhaust if there are

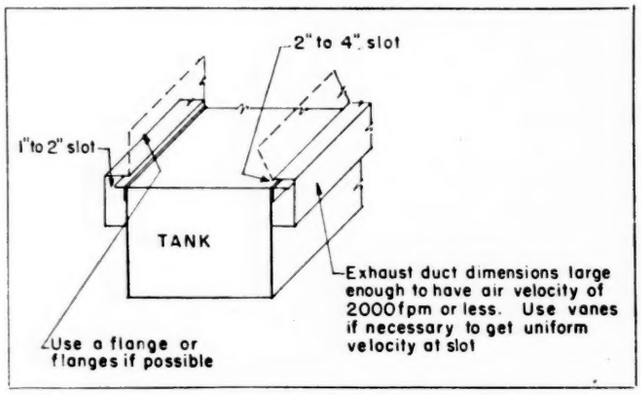
2" to 4" slot
1" to 2" slot
TANK
Exhaust duct dimensions large enough to have air velocity of 2000 fpm or less. Use vanes if necessary to get uniform velocity at slot
Use a flange or flanges if possible

Fig. 1—Slot type exhaust hoods for tanks.

adjoining occupied spaces and a slight excess of supply if there are no adjoining occupied spaces;

(f) Supply only will contaminate air of adjoining occupied spaces.

Local Exhaust Ventilation. This control measure is best suited to production or assembly line operations but may be applied in some instances to intermittent cleaning operations. It is probably the most foolproof of all control measures and is positive in its operation if properly designed and maintained since it removes the contaminated air at its source or before it reaches the general room air. Control provided by proper local exhaust ventilation does not break down completely if the rate of vapor production is increased by an operational speed-up or if a more toxic solvent is used by mistake. Furthermore, it permits the use, with safety, of the best solvent available, even if relatively toxic rather than limiting the selection to a relatively unsatisfactory solvent.

Local exhaust ventilation functions by producing air movement at the source of the vapor release in such direction and of such magnitude that the vapor or highly contaminated air is drawn into the exhaust hood before it enters the breathing zone of the operator, or the general workroom air. The proper direction of air movement is obviously toward the exhaust hood and the proper magnitude will vary with the nature of the operation but for vapors, in general, a velocity of 100 to 200 fpm is adequate. To determine the required minimum control velocity consideration must be given to overcoming convection currents, differences in specific gravity, interfering air movement, and the like. It must be borne in mind that 200 fpm is a very low velocity,—the average man walks at the rate of four miles per hour or about 350 fpm. Consequently, it is apparent that a control velocity as low as 200 fpm will be disturbed by air currents from open doors or windows, by fast moving nearby equipment, overhead cranes, and the like. These adverse influences must be kept in mind in the design of local exhaust systems and particularly local exhaust hoods. If these adverse influences can be eliminated a control velocity of 100 fpm will suffice, as a rule, to capture vapors released by evaporation at room temperatures.

Local exhaust hoods for operations involving solvents, thinners, or "cleaners" are of three fundamental types,—namely (a) enclosing or partially enclosing hoods, (b) slot type hoods, and (c) rectangular or round hoods. Owing to the different types of velocity contour patterns produced by these hoods the quantity of air which must be exhausted through each to create the required control velocity at the proper location varies considerably.

Enclosing or Partially Enclosing Hoods. Hoods of this type are preferred since they automatically eliminate most of the conditions which might disturb the control velocity patterns; they present a "defense in depth" air flow pattern; and are the most efficient from the point of view of effective air flow. Enclosures should be used wherever possible but they are obviously limited to those operations where they will not interfere too much with the efficient performance of the operation. The quantity of air which must be exhausted may be determined by means of the following equation:

$$Q = AV$$

where Q = quantity of air, cubic feet per minute;
A = entire area of the hood opening, square feet; and
V = control velocity, in feet per minute, required to prevent escape of vapor from the enclosure.

Obviously it is advantageous to keep the hood opening as small as is consistent with good performance of the operation, since by so doing the required ventilation rate is decreased accordingly.

Slot Type Exhaust Hoods. Such hoods are commonly used to obtain local exhaust ventilation at tank tops, table or work bench tops, conveyor belts or lines, and the like. The hoods are usually of considerable length extending along one or both sides of the tank, table, or conveyor. Flanges at the hoods are very helpful since they reduce the amount of air entering the hoods from the ineffective areas and therefore reduce the quantity required to obtain the required minimum control velocity at the source, or in the area, of vapor release. The quantity of air which must be exhausted through slot type hoods may be computed by means of the following general equation developed by Battista, Hatch & Greenberg:

$$Q = KLWV$$

where Q = quantity of air, cubic feet per minute;
K = a constant which varies with conditions (see following paragraph);
L = length, in feet, of tank, or of table or conveyor over which vapor is released;

W = distance, in feet, from hood to remotest source of vapor release (for tanks and for some tables and conveyors it represents width in feet); and

V = control velocity, in feet per minute, required to capture vapor or contaminated air.

For a freely suspended slot type hood without flanges, air enters more or less uniformly through the entire area surrounding the hood—the approximate area of a cylinder with the hood face as the axis. In such cases, according to Silverman, K is approximately 3.7. For slot hoods at tanks, table tops, or with a wide flange along one edge the author has found K to be approximately 2.8. For slot hoods at tanks, tables, or conveyors with a wide flange extending at right angles with the tank or table top K is approximately 1.5.

Rectangular or Round Hoods. Such hoods are less efficient in most instances than those discussed previously since ineffective air enters from all sides and the velocity decreases approximately as the square of the distance from the hoods. The reason for this becomes apparent if it is remembered that the area of a contour at some distance from the hood opening is approximately that of a sphere. Here again the use of flanges is very important and the quantity of air may be reduced approximately 25% below that calculated by the equation given below if flanges can be used. The quantity of air which must be removed through hoods of this type to capture the escaping vapor or highly contaminated air may be calculated by Dalla Valle's equation:

$$Q = V(10x^2 + a)$$

where Q = quantity of air, cubic feet per minute;
V = control velocity, feet per minute;
x = distance in feet from hood to remotest source of vapor release; and
a = area of hood opening, square feet.

It should be observed in the foregoing equations that the control velocity is a function of Q, not of the hood velocity, and cannot be increased by increasing the hood velocity so long as Q remains constant. This is very important because it is a much too common practice in many industries to attempt to improve the control by increasing the hood velocity rather than by increasing Q or redesigning the hood to improve its air flow characteristics.

Local exhaust ventilating systems for many operations involving vapor release need not be expensive if properly designed. Frequently, propeller type or other axial flow fans can be used if the duct velocity and hood entrance losses are kept low. Centrifugal fans are preferred, however, and should be used if available or if obtainable, particularly on permanent or "long-time" installations. A fair percentage of the operations involving solvents in war industries today are day-to-day or month-to-month operations and are changed frequently and on short notice. For such operations, in particular, low resistance systems of simple design and using propeller fans are advisable.

Specific Applications

Most solvents, thinners, and cleaners are used in three general types of operations: (1) degreasing, (2) cleaning, and (3) finishing (painting, lacquering, etc.). Consequently, these three specific types of operations and the vapor control measures will be discussed in further detail.

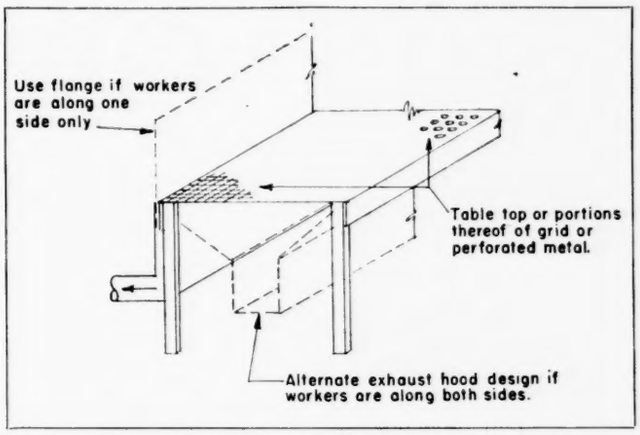
Use flange if workers are along one side only
Table top or portions thereof of grid or perforated metal.
Alternate exhaust hood design if workers are along both sides.

Fig. 2—Down draft hoods in table tops.

Degreasing. Degreasing is most commonly accomplished by immersing the parts to be degreased into tanks, vats, or other containers of the degreasing solvent. Some degreasing, however, is done by applying the solvent to the parts to be degreased by means of cloths or brushes and some is done by spraying the solvent on the objects by means of paint spray guns. Control for the latter two degreasing procedures is similar to that for "cleaning" and painting, respectively, and will be discussed under those headings.

Tank type degreasers may be of either the liquid or vapor type. Since the vapor control measures are similar, no differentiation will be made between the two types of degreasers. There are commercially available today small tank type degreasers of such design that if installed, maintained, and operated properly, do not require exhaust ventilation to prevent the existence of a health hazard. Large tanks (over 10 square feet area) frequently require local exhaust ventilation. Most small tanks of good design and some large tanks will not require local exhaust ventilation if the following rules formulated by Morse and Goldberg are observed:

(1) Maintain a careful heat balance (adjust the heat input and the cooling capacity of the condensing coils properly so that there is no tendency to "boil over");

(2) Maintain an ample "free board" to prevent "boiling over" and to reduce to a minimum the amount of vapor carried out by air currents;

(3) Locate degreasers in large rooms with good general ventilation, but away from doors and windows since excessive air movement in the vicinity of degreasers must be avoided;

(4) Withdraw cleaned parts from degreaser slowly—rate not to exceed 20 feet per minute;

(5) Support parts to be degreased in baskets or

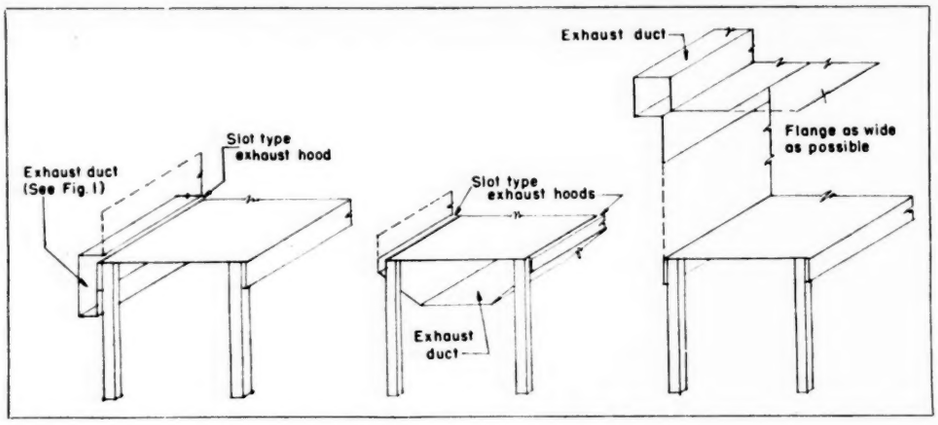

Fig. 3—Lateral exhaust hoods at work benches.

on frames in such position that liquid solvent drains as completely as possible;

(6) Do not permit moist parts to dry in the general room air; and

(7) Enclose degreasers as much as possible and keep them covered when not in use.

Local exhaust ventilation must be provided when other control measures do not keep the atmospheric concentration of solvent vapor substantially below the maximum allowable concentration. Where local exhaust ventilation is required, it should be provided at the rate determined by:

$$Q = 50\ LW$$

where Q = exhaust ventilation rate, cubic feet per minute;
L = length of tank, feet; and
W = width of tank, feet.

NOTE: The product LW represents the tank area in square feet for rectangular or square tanks. For tanks or containers of other shape use the tank area in square feet.

For long and narrow tanks (20 inches wide or less) a slot type hood along one long side of the tank will suffice even though hoods along both long sides are preferred. For wide tanks the hoods should be located at least along both long sides and preferably around the entire perimeter. Fig. 1 illustrates the shape of hoods commonly employed at degreasers. Better control is accomplished with flanged hoods than with unflanged hoods (see dotted flanges in Fig. 1). It is important that the ventilation rate determined by the foregoing equation not be exceeded very much since a substantially higher ventilation rate will probably result in an excessive rate of solvent loss.

Attention of design engineers must be called to much-too-common errors in design resulting from attempts to take "full" advantage of the difference in specific gravity between solvent vapors and air. The author has seen so-called local exhaust ventilating systems for degreasers in which the exhaust hoods consisted of grill covered ducts in the floor at the base of the degreaser. This design was prompted by the fact that trichloroethylene vapor is over four times as heavy as air and the designer was proud of his installation since it was easy to accomplish and did not interfere at all with the operation of the degreaser. The fallacy in this line of reasoning lies in the fact that concentrated vapors of the solvent do not escape from the tank if operated properly—only small amounts of the solvent (vapor-in-air mixtures) will escape from the degreaser. Even though these vapor-in-air concentrations may be many times the maximum allowable concentration from the health viewpoint they are very low in terms of percentage—seldom exceeding 1% or 10,000 parts per million parts of air. Such mixture weighs only 3½% more than air and certainly will not drop to the floor with any great vigor.

It must not be concluded, however, that the specific gravity of a contaminant is of no consequence in the design of local exhaust systems. Specific gravity as well as temperature difference, prevailing air currents, and other factors must be considered but the primary considerations in the locations of exhaust hoods must be (1) locate the hoods in the line of throw or escape of the contaminant, and (2) locate the hood as close as possible to (or enclose) the point or area of contaminant release.

In many instances less atmospheric contamination is produced by the degreasing than by the subsequent operation of drying the cleaned parts. This is particularly true if the parts being degreased have voids which retain some of the solvent as they are withdrawn from the degreaser, or if they are withdrawn too rapidly and then permitted to dry in the room. For all degreasing operations where the parts cannot be withdrawn free of the solvent a down draft drain table or a suitable exhaust ventilated enclosure must be provided for drying the parts. If the degreaser is not overloaded and the parts drain well, complete drying may be accomplished by a slow rate of withdrawal or by suspension in the upper part of the tank before removing. A down draft drain table located adjacent to the degreaser and draining thereinto, or into some other suitable vessel, will provide adequate control. If the moist parts are transported from the degreaser to the next operation on conveyors, such conveyors should be enclosed and exhaust ventilated for sufficient distance to accomplish complete drying. In lieu of these measures, small exhaust ventilated drying rooms located close to the degreasers will provide adequate control.

As stated earlier, degreasing operations involving the application of the solvent to the part to be

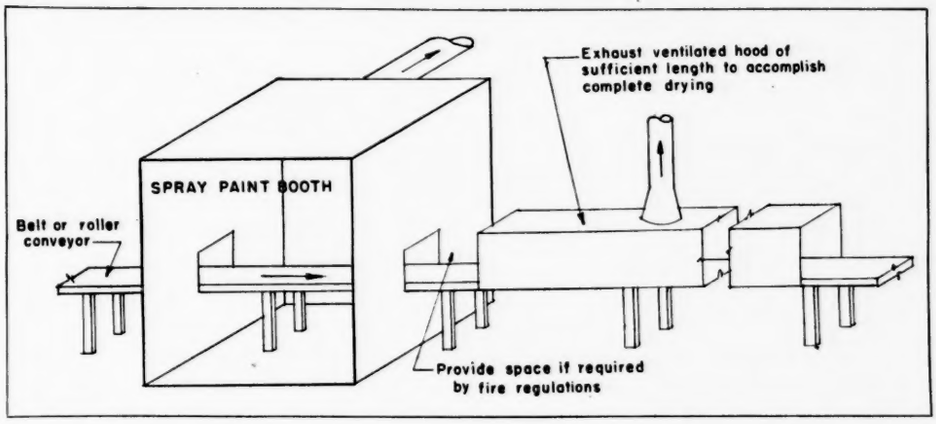
Exhaust ventilated hood of sufficient length to accomplish complete drying
SPRAY PAINT BOOTH
Belt or roller conveyor
Provide space if required by fire regulations

Fig. 4 — Exhaust ventilated spray booth and drying tunnel.

cleaned by means of cloths or brushes are covered under "cleaning." Also the degreasing operations accomplished by spraying the solvent onto the part to be cleaned should be considered the same as spray painting as regards the health hazards and their control.

Cleaning. Under this heading fall the many and varied, usually miscellaneous, operations such as touch-up cleaning of finished parts, maintenance cleaning of equipment, and production cleaning of parts which do not permit of cleaning by immersion.

Many of the maintenance cleaning operations such as type cleaning and equipment cleaning do not present important health hazards owing to the fact that they are intermittent in nature and are frequently done in large rooms. Equipment or machine cleaning involving an hour or more per operation will create a serious hazard if done in small rooms or bays. All production cleaning or touch-up presents a serious chronic health hazard and requires control measures.

For maintenance cleaning of equipment in small rooms adequate control of the health hazard may be accomplished by means of local exhaust ventilation, general ventilation, or respiratory protection. For small pieces of equipment, local exhaust ventilation will serve satisfactorily but in general the most practical measure is general ventilation produced by means of portable blowers with light weight ductwork or tubes to convey uncontaminated air from the blower outside the room to the point or zone of operation. The air should be directed over the equipment or machine and away from the worker. By so doing the worker is not exposed to the high vapor concentrations and the general ventilation provided to the room will prevent the general room concentration from attaining a hazardous level. The volume of air needed can be determined by means of the equation given previously for general ventilation, since the amount of solvent per machine or per hour can be determined readily. The quantity of air actually supplied should be not less than twice that estimated on this basis and should preferably be four or five times the amount calculated.

Respirators can be used to protect the workers if the exposure periods are short, an hour or less, but general ventilation is the preferred method. If the vapor concentrations are not very high (1000 ppm or less) chemical cartridge respirators (twin cartridge type) will suffice, but for higher concentrations gas masks or supplied-air respirators are recommended.

Most production cleaning or touch-up operations require mechanical ventilation to control the health hazard adequately. This is not necessarily true if the solvent is low on the scales of volatility and toxicity, and if the operation is done in a room with good air circulation and good general ventilation. Even in such instances, however, some mechanical ventilation is advisable to avoid the consequences which would result from an accidental change to a more toxic or more volatile solvent. For cleaning operations of this nature adequate ventilation may be provided, as a rule, at no great expense if the system is properly designed but not over-designed.

Only a careful study of the problem will permit the best design. In general, local exhaust ventilation through partial enclosures, down draft tables, or lateral exhaust hoods may be employed with better results than good general ventilation and air circulation. Adequate general ventilation as determined by the equation given earlier in this paper with good air circulation, or preferably blowing tempered clean air over the cleaning operations and away from the operators works well for individual or scattered operations.

Fig. 2 shows the cross sectional shape of one type of down draft table for cleaning parts of relatively small size. The hood or duct beneath the table may be of any suitable shape to best accomplish uniform air flow and not interfere with the workers. Flanges or partitions at the table top will improve the control considerably and should be employed if practicable.

If the parts to be cleaned are large flat solid objects or large sections of impervious materials, down draft cannot be used since the object being processed closes off a large portion of the grille and nullifies the air flow control pattern in the area of vapor release. For such operations and for others where down draft is not practicable, lateral exhaust ventilation with or without flanges (see Fig. 3) may be used. The required ventilation rate for such hoods was given previously (see slot type exhaust hoods).

If the operations are such that they can be con-

ducted in hoods or partial enclosures better control will be accomplished with lower ventilation rates since the area through which the control velocity must be maintained is smaller than with other types of hoods. In most instances of production cleaning, however, no great degree of enclosure is practicable.

Finishing. In this group are considered operations such as painting and lacquering. With but few exceptions, finishing operations of a production nature are conducted in exhaust ventilated booths. Not infrequently, however, the ventilation rates encountered are less than those recommended. Some production finishing operations, such as lacquering, are done by immersing the parts into vats or tanks of the lacquer or paint. For such operations the same control measures should be used as for degreasing. Maintenance, touch-up, and repair painting frequently cannot be done in adequately exhaust ventilated booths or rooms. For work of this nature good general ventilation, and respirators, are satisfactory.

All production spray painting and spray lacquering, whether mechanical or manual, should be done in properly designed and adequately exhaust ventilated booths. For large booths (over 50 sq ft face area) an average air velocity of at least 150 fpm into the booth should be maintained, and for small booths this velocity should be not less than 200 fpm. Where spraying is done manually provision should be made to permit the worker to remain on the clean air side of the operation at all times. Turntables, swivelled supports, and the like, may be used to advantage.

Fortunately most production painting operations are controlled adequately and many of the booths available commercially are of good design. In many instances, however, the solvent or thinner vapor problem while drying has been neglected or overlooked. Very seldom does the paint dry before the painted article leaves the spray booth. In some few cases the work can be so arranged that it can be held or stored in the booth long enough to permit it to dry completely. As a rule, however, it is necessary to provide an exhaust ventilated tunnel or hood for painted parts which leave the booths on conveyors, and to provide exhaust ventilated enclosures close to the painting booths for drying articles which are handled manually. If the fire regulations prevent having a drying room or tunnel attached to the paint booth it may be separated as far as necessary, and adequate control will still be accomplished by air entering the drying enclosure and the painting booth. The drying enclosures may be heated, if desired, but should be exhaust ventilated at such rate that there is an inward air velocity of at least 100 fpm through all openings in the enclosure when the dryer, conveyor, and other equipment are in operation. The required ventilation rate can be kept at a very low value by enclosing the drying area as much as possible but higher ventilation rates are usually desirable to accomplish rapid paint drying. Fig. 4 shows a sketch of a booth with conveyor and tunnel type dryer.

Production or repair painting of large objects such as tanks, trucks, gun carriages and the like, presents a difficult control problem. Effective local exhaust ventilation is generally impractical and the only satisfactory procedure is to partially or wholly enclose the painting stations and to provide exhaust ventilation at the rate of 15 to 30 air changes per hour to prevent contamination of the other parts of the room, and to prevent excessive contamination of the air within the enclosure. To protect the painters and other nearby workers appropriate respirators should be worn. Supplied-air (air-line) respirators are preferred but chemical cartridge respirators are satisfactory for some operations.

STEAM FLASH FOR VARIOUS PRESSURES AND CONDENSATE QUANTITIES

Absolute Steam Pressure Lb. per Sq. In.	POUNDS OF WATER DISCHARGED TO ATMOSPHERE									
	100	200	300	400	500	600	700	800	900	1000
	STEAM FLASH IN POUNDS									
15	0.11	0.22	0.33	0.44	0.55	0.66	0.77	0.88	0.99	1.10
16	0.45	0.90	1.35	1.80	2.25	2.70	3.15	3.60	4.05	4.50
17	0.77	1.54	2.31	3.08	3.85	4.62	5.39	6.16	6.93	7.70
18	1.08	2.16	3.24	4.32	5.40	6.48	7.56	8.64	9.72	10.80
19	1.37	2.74	4.11	5.48	6.85	8.22	9.59	10.96	12.33	13.70
20	1.66	3.32	4.98	6.64	8.30	9.96	11.62	13.28	14.94	16.60
22	2.19	4.38	6.57	8.76	10.95	13.14	15.33	17.52	19.71	21.90
24	2.69	5.38	8.07	10.76	13.45	16.14	18.83	21.52	24.21	26.90
26	3.15	6.30	9.45	12.60	15.75	18.90	22.05	25.20	28.35	31.50
28	3.58	7.16	10.74	14.32	17.90	21.48	25.06	28.64	32.22	35.80
30	3.99	7.98	11.97	15.96	19.95	23.94	27.93	31.92	35.91	39.90
35	4.93	9.86	14.79	19.72	24.65	29.58	34.51	39.44	44.37	49.30
40	5.76	11.52	17.28	23.04	28.80	34.56	40.32	46.08	51.84	57.60
45	6.52	13.04	19.56	26.08	32.60	39.12	45.64	52.16	58.68	65.20
50	7.21	14.42	21.63	28.84	36.05	43.26	50.47	57.68	64.89	72.10
55	7.85	15.70	23.55	31.40	39.25	47.10	54.95	62.80	70.65	78.50
60	8.45	16.90	25.35	33.80	42.25	50.70	59.15	67.60	76.05	84.50
65	9.01	18.02	27.03	36.04	45.05	54.06	63.07	72.08	81.09	90.10
70	9.53	19.06	28.59	38.12	47.65	57.18	66.71	76.24	85.77	95.30
75	10.03	20.06	30.09	40.12	50.15	60.18	70.21	80.24	90.27	100.3
80	10.50	21.00	31.50	42.00	52.50	63.00	73.50	84.00	94.50	105.0
85	10.95	21.90	32.85	43.80	54.75	65.70	76.65	87.60	98.55	109.5
90	11.38	22.76	34.14	45.52	56.90	68.28	79.66	91.04	102.4	113.8
95	11.80	23.60	35.40	47.20	59.00	70.80	82.60	94.40	106.2	118.0
100	12.20	24.40	36.60	48.80	61.00	73.20	85.40	97.60	109.8	122.0
110	12.95	25.90	38.85	51.80	64.75	77.70	90.65	103.6	116.6	129.5
120	13.64	27.28	40.92	54.56	68.20	81.84	95.48	109.1	122.8	136.4
130	14.30	28.60	42.90	57.20	71.50	85.80	100.1	114.4	128.7	143.0
140	14.92	29.84	44.76	59.68	74.60	89.52	104.4	119.4	134.3	149.2
150	15.51	31.02	46.53	62.04	77.55	93.06	108.6	124.1	139.6	155.1
160	16.06	32.12	48.18	64.24	80.30	96.36	112.4	128.5	144.5	160.6
170	16.60	33.20	49.80	66.40	83.00	99.60	116.2	132.8	149.4	166.0
180	17.11	34.22	51.33	68.44	85.55	102.7	119.8	136.9	154.0	171.1
190	17.60	35.20	52.80	70.40	88.00	105.6	123.2	140.8	158.4	176.0
200	18.07	36.14	54.21	72.28	90.35	108.4	126.5	144.6	162.6	180.7
220	18.97	37.94	56.91	75.88	94.85	113.8	132.8	151.8	170.7	189.7
240	19.80	39.60	59.40	79.20	99.00	118.8	138.6	158.4	178.2	198.0
260	20.59	41.18	61.77	82.36	103.0	123.5	144.1	164.7	185.3	205.9
280	21.34	42.68	64.02	85.36	106.7	128.0	149.4	170.7	192.1	213.4
300	22.05	44.10	66.15	88.20	110.3	132.3	154.4	176.4	198.5	220.5
320	22.72	45.44	68.16	90.88	113.6	136.3	159.0	181.8	204.5	227.2
340	23.37	46.74	70.11	93.48	116.9	140.2	163.6	187.0	210.3	233.7
360	24.00	48.00	72.00	96.00	120.0	144.0	168.0	192.0	216.0	240.0
380	24.59	49.18	73.77	98.36	123.0	147.5	172.1	196.7	221.3	245.9
400	25.17	50.34	75.51	100.7	125.9	151.0	176.2	201.4	226.5	251.7
420	25.73	51.46	77.19	102.9	128.7	154.4	180.1	205.8	231.6	257.3
440	26.26	52.52	78.78	105.0	131.3	157.6	183.8	210.1	236.3	262.6
460	26.79	53.58	80.37	107.2	134.0	160.7	187.5	214.3	241.1	267.9
480	27.30	54.60	81.90	109.2	136.5	163.8	191.1	218.4	245.7	273.0
500	27.80	55.60	83.40	111.2	139.0	166.8	194.6	222.4	250.2	278.0
520	28.28	56.56	84.84	113.1	141.4	169.7	198.0	226.2	254.5	282.8
540	28.76	57.52	86.28	115.0	143.8	172.6	201.3	230.1	258.8	287.6
560	29.23	58.46	87.69	116.9	146.2	175.4	204.6	233.8	263.1	292.3
580	29.68	59.36	89.04	118.7	148.4	178.1	207.8	237.4	267.1	296.8
600	30.13	60.26	90.39	120.5	150.7	180.8	210.9	241.0	271.2	301.3
620	30.57	61.14	91.71	122.3	152.9	183.4	214.0	244.6	275.1	305.7
640	31.00	62.00	93.00	124.0	155.0	186.0	217.0	248.0	279.0	310.0
660	31.43	62.86	94.29	125.7	157.2	188.6	220.0	251.4	282.9	314.3
680	31.84	63.68	95.52	127.4	159.2	191.0	222.9	254.7	286.6	318.4
700	32.25	64.50	96.75	129.0	161.3	193.5	225.8	258.0	290.3	322.5
720	32.65	65.30	97.95	130.6	163.3	195.9	228.6	261.2	293.9	326.5
740	33.04	66.08	99.12	132.2	165.2	198.2	231.3	264.3	297.4	330.4
760	33.44	66.88	100.3	133.8	167.2	200.6	234.1	267.5	301.0	334.4
780	33.83	67.66	101.5	135.3	169.2	203.0	236.8	270.6	304.5	338.3
800	34.20	68.40	102.6	136.8	171.0	205.2	239.4	273.6	307.8	342.0
820	34.58	69.16	103.7	138.3	172.9	207.5	242.1	276.6	311.2	345.8
840	34.94	69.88	104.8	139.8	174.7	209.6	244.6	279.5	314.5	349.4
860	35.31	70.62	105.9	141.2	176.6	211.9	247.2	282.5	317.8	353.1
880	35.66	71.32	107.0	142.6	178.3	214.0	249.6	285.3	320.9	356.6
900	36.02	72.04	108.1	144.1	180.1	216.1	252.1	288.2	324.2	360.2
920	36.37	72.74	109.1	145.5	181.9	218.2	254.6	291.0	327.3	363.7
940	36.71	73.42	110.1	146.8	183.6	220.3	257.0	293.7	330.4	367.1
960	37.06	74.12	111.2	148.2	185.3	222.4	259.4	296.5	333.5	370.6
980	37.39	74.78	112.2	149.6	187.0	224.3	261.7	299.1	336.5	373.9
1000	37.72	75.44	113.2	150.9	188.6	226.3	264.0	301.8	339.5	377.2
1050	38.55	77.10	115.7	154.2	192.8	231.3	269.9	308.4	347.0	385.5
1100	39.34	78.68	118.0	157.4	196.7	236.0	275.4	314.7	354.1	393.4
1150	40.12	80.24	120.4	160.5	200.6	240.7	280.8	321.0	361.1	401.2
1200	40.87	81.74	122.6	163.5	204.4	245.2	286.1	327.0	367.8	408.7
1250	41.60	83.20	124.8	166.4	208.0	249.6	291.2	332.8	374.4	416.0
1300	42.32	84.64	127.0	169.3	211.6	253.9	296.2	338.6	380.9	423.2
1350	43.03	86.06	129.1	172.1	215.2	258.2	301.2	344.2	387.3	430.3

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STEAM FLASH FOR VARIOUS PRESSURES AND CONDENSATE QUANTITIES

The tabulation on the front of this sheet, designed by Charles A. Pohlig, is for determining the amount of steam flash for various quantities of discharge and steam pressures where steam traps or other equipments are discharging condensate to the atmosphere.

The table is so arranged that knowing the steam pressure and the steam quantity the user will find in the body of the table the number of pounds of steam formed at atmospheric pressure. In other words, the table is a solution of the equation

$$Y = \frac{A-B}{C}$$

for 100 to 1000 lb quantities in increments of 100 lb,

where Y = steam flash in pounds per pound of condensate.
A = heat of liquid at condensing pressure, Btu per pound,
B = heat of liquid at atmospheric pressure, Btu per pound, and
C = heat of vaporization at atmospheric pressure, Btu per pound.

Example: Five hundred pounds of steam at 140 lb per sq in absolute pressure is discharged by a trap to atmosphere. How much flash steam will be formed?

Solution: In the table, opposite 140 in the left column and under 500 in the top horizontal column find 74.60 lb of flash steam.

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Graphical Determination of Heat Transfer Film Coefficient for Brine†

B. F. RABER* and F. W. HUTCHINSON**

THE graphical solutions presented in this month's installment of the heat transfer series are for a 25% solution of calcium chloride brine. As for the fluids previously covered, two graphs are presented, one for flow through a pipe and the other for flow outside and normal to a single pipe. The construction and method of use of the brine charts is exactly as for the water[1], ammonia[2], and sulfur dioxide[3] charts, hence will not again be discussed. In one respect, however, the brine charts are subject to a limitation which has not previously been commented on: the fundamental Nusselt equation from which all the charts are plotted[1] is for heat transfer during turbulent flow and consequently is not valid below certain limiting values for the Reynolds number. For brine the minimum permissible value sometimes occurs in the range of velocities used in practice, so that it is necessary before using the charts to check the turbulence by noting whether or not the product of velocity (feet per second) and diameter (inches) exceeds the minimum permissible value. This value varies inversely with temperature, decreasing from approximately 2.0 at 50F to .5 at 200F. Thus at 200F, for example, the charts could not be used for ¼ inch pipe except when the fluid velocity was greater than 2 feet per second.

Thermal Resistance of Type L Tubing

Continuing with the presentation of tabulations of film and wall resistances per lineal foot of standard tubing, a table is given for *Type L* tubing including most of the more commonly specified alloys. As with the tables already presented (standard iron pipe[2], Type K tubing[3]) the method of use is to enter at the value of h_i or n_o as determined from the charts for the fluid in question, move horizontally to the respective r_i or r_o columns under the known nominal pipe size and read directly the thermal resistance of the inside or outside film per lineal foot of pipe. Adding these two film resistances to the pipe wall

†Similar articles on water, ammonia and sulfur dioxide appeared in the December, 1944, January and February, 1945, issues of HEATING AND VENTILATING.

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[1]HEATING AND VENTILATING, December, 1944.
[2]HEATING AND VENTILATING, January, 1945.
[3]HEATING AND VENTILATING, February, 1945.

TABLE 3.—THERMAL RESISTANCES PER LINEAL FOOT OF TYPE L STANDARD TUBING

(r_i = Inside film resistance; r_p = pipe wall resistance; r_o = outside film resistance; h = film coefficient of heat transfer from charts)

MATERIAL*	TUBING DIAMETER, INCHES																	
	¼		½		¾		1		1½		2		2½		3		3½		4	
	Values of r_p																			
E.Cu.[1]	.000122		.0000956		.0000760		.0000651		.0000538		.0000477		.0000440		.0000416		.0000398		.0000384	
P.Cu.[2]	.000148		.000116		.0000922		.0000790		.0000653		.0000580		.0000535		.0000505		.0000483		.0000467	
R.Br.[3]	.000318		.000250		.000198		.000170		.000140		.000125		.000116		.000108		.000104		.000100	
C.Br.[4]	.000395		.000310		.000246		.000211		.000174		.000155		.000143		.000135		.000129		.000125	
Y.Br.[5]	.000401		.000315		.000250		.000214		.000177		.000157		.000145		.000137		.000131		.000126	
Mz.M.[6]	.000379		.000298		.000236		.000202		.000168		.000148		.000137		.000129		.000124		.000119	
Ad.M.[7]	.000432		.000339		.000269		.000231		.000191		.000169		.000156		.000147		.000141		.000136	
Cu.N.[8]	.00163		.00128		.00101		000870		.000718		.000638		.000588		.000555		.000531		.000513	
h	r_i	r_o	r_i	r_o	r_i	r_o	r_i	r_o	r_i	r_o	r_i	r_o	r_i	r_o	r_i	r_o	r_i	r_o	r_i	r_o
50	.242	.204	.140	.122	.0972	.0874	.0746	.0678	.0508	.0472	.0384	.0360	.0310	.0291	.0259	.0244	.0223	.0211	.0196	.0185
100	.121	.102	.0700	.0610	.0486	.0437	.0373	.0339	.0254	.0236	.0192	.0180	.0155	.0145	.0130	.0122	.0111	.0105	.000980	.00927
200	.0605	.0509	.0350	.0305	.0243	.0219	.0187	.0170	.0127	.0118	.00962	.00900	.00775	.00727	.00649	.00611	.00557	.00527	.00490	.00463
300	.0404	.0336	.0233	.0203	.0162	.0146	.0124	.0113	.00847	.00785	.00642	.00600	.00517	.00485	.00432	.00407	.00372	.00352	.00327	.00309
400	.0303	.0255	.0175	.0153	.0122	.0109	.00934	.00847	.00635	.00589	.00481	.00450	.00388	.00364	.00324	.00306	.00279	.00264	.00245	.00232
500	.0242	.0204	.0140	.0122	.00972	.00874	.00746	.00678	.00508	.00472	.00384	.00360	.00310	.00291	.00259	.00244	.00223	.00211	.00196	.00185
600	.0202	.6109	.0117	.0102	.00810	.00728	.00622	.00565	.00423	.00392	.00321	.00300	.00258	.00242	.00216	.00204	.00186	.00176	.00163	.00154
700	.0173	.0145	.0100	.00871	.00694	.00623	.00534	.00485	.00363	.00336	.00275	.00257	.00222	.00208	.00185	.00175	.00159	.00151	.00140	.00132
800	.0152	.0127	.00875	.00763	.00607	.00545	.00467	.00424	.00317	.00294	.00241	.00225	.00194	.00182	.00162	.00153	.00139	.00132	.00122	.00116
900	.0135	.0113	.00779	.00677	.00540	.00485	.00415	.00377	.00282	.00262	.00214	.00200	.00172	.00162	.00144	.00136	.00124	.00117	.00109	.00103
1000	.0121	.0102	.00700	.00610	.00486	.00437	.00373	.00339	.00254	.00236	.00192	.00180	.00155	.00145	.00130	.00122	.00111	.00105	.000980	.000927
1100	.0110	.00925	.00636	.00555	.00442	.00395	.00349	.00308	.00231	.00214	.00175	.00163	.00141	.00132	.00118	.00111	.00101	.000959	.000891	.000843
1200	.0101	.00848	.00584	.00508	.00405	.00364	.00311	.00282	.00212	.00196	.00160	.00150	.00129	.00121	.00108	.00102	.000929	.000879	.000817	.000772
1300	.00933	.00733	.00539	.00469	.00374	.00336	.00287	.00261	.00195	.00181	.00148	.00138	.00119	.00112	.000998	.000940	.000858	.000811	.000754	.000714
1400	.00866	.00726	.00500	.00436	.00347	.00312	.00266	.00242	.00181	.00168	.00137	.00128	.00111	.00104	.000927	.000873	.000796	.000754	.000700	.000661
1500	.00809	.00679	.00467	.00406	.00324	.00290	.00249	.00226	.00169	.00157	.00128	.00120	.00103	.000971	.000865	.000815	.000743	.000703	.000654	.000618
1600	.00758	.00635	.00437	.00381	.00304	.00272	.00233	.00212	.00158	.00147	.00120	.00112	.000970	.000910	.000811	.000764	.000696	.000659	.000613	.000579
1700	.00714	.00599	.00411	.00359	.00286	.00256	.00220	.00199	.00149	.00138	.00113	.00106	.000912	.000857	.000763	.000719	.000656	.000620	.000577	.000545
1800	.00674	.00565	.00389	.00339	.00270	.00242	.00207	.00188	.00141	.00131	.00107	.00100	.000861	.000810	.000721	.000679	.000619	.000586	.000545	.000515
1900	.00639	.00535	.00368	.00321	.00256	.00230	.00196	.00178	.00133	.00124	.00101	.000947	.000816	.000766	.000682	.000644	.000587	.000555	.000516	.000488
2000	.00605	.00509	.00350	.00305	.00243	.00219	.00187	.00170	.00127	.00118	.000962	.000900	.000775	.000727	.000649	.000611	.000557	.000527	.000490	.000463

*Due to space limitations the materials below are abbreviated: [1]Electrolytic copper; [2]Phosphorized copper; [3]85% Red brass; [4]Cartridge brass; [5]66% Yellow brass; [6]Muntz metal; [7]Admiralty metal; [8]30% Cupro-nickel.

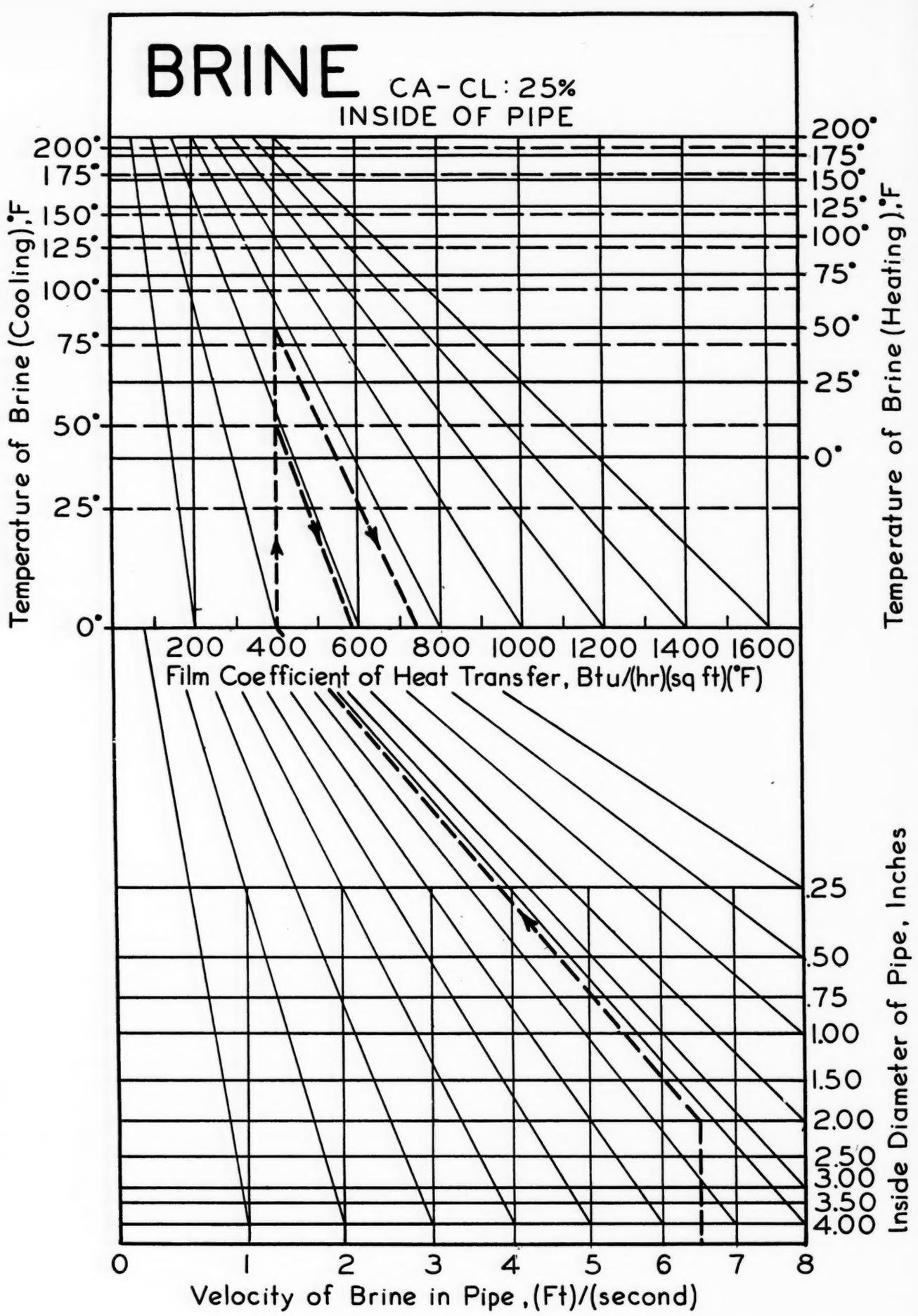

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Fig. 7. Film coefficient for brine flowing inside a pipe.

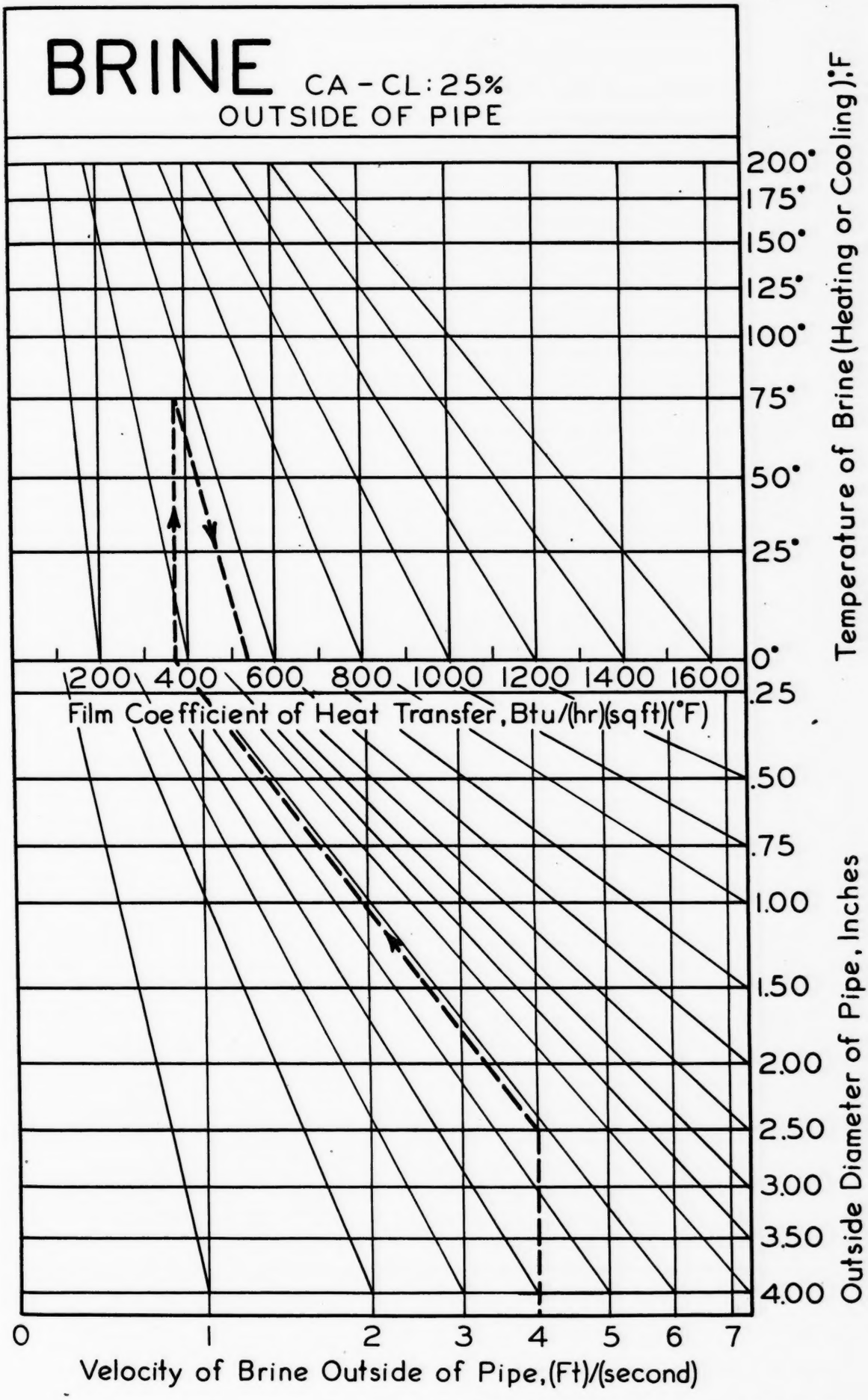

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Fig. 8. Film coefficient for brine flowing outside a pipe.

resistance (as read for the correct nominal size and actual alloy) gives the overall fluid-to-fluid resistance which is itself the inverse of the overall coefficient of heat transfer, U.

Irregular Cross-Sections

Flow in annular spaces (as in a double-pipe exchanger) and flow parallel to the tubes in a shell-and-tube exchanger were taken up in the last article. An extension of the same procedure to a single tube of non-circular cross-section leads to the conclusion that the standard charts can be used for any shape tube provided only that an equivalent tube diameter equal to four times the actual cross-section area divided by the circumferences, is used in place of the nominal d_i or d_o of a circular cross-section tube. This approximation is quite accurate for flow within a conduit even when the perimeter has discontinuities, as in a rectangular duct or conduit; for flow outside and normal to the pipe the accuracy is less dependable but no other method of equal generality and comparable accuracy has yet been found.

Flow Inside Helical Coils

Film resistance decreases as turbulence increases, hence one would expect the film coefficient for flow within a coiled pipe to be greater than that for flow at the same velocity through straight pipe having the same diameter. Richter, experimenting with a double pipe water-to-water exchanger, found a 20% increase in the overall coefficient; McAdams suggests that for practical problems of liquid flow in coils the effect of helical winding can be adequately expressed as a correction to the basic coefficient such that,

$$h_c = h_i \left(1 + \frac{3.5 d_i}{d_c}\right)$$

where: h_c = film coefficient for liquid flowing in a helically coiled pipe where coil diameter is d_c

h_i = chart value of film coefficient in a pipe having inside diameter d_i.

Influence of Pipe Roughness

From the relationship between turbulence and convection, one would expect the film coefficient to increase as a function of roughness. Experimental work (by Cape and others) has shown, however, that variations in internal pipe roughness sufficient to have pronounced effect on pressure drop do not significantly alter the inside film coefficient. For most practical calculations it can therefore be considered that roughness is not an important factor and need not be considered in evaluating h_i.

Flow Outside and Normal to Tube Bundles

Stoever recommends a 30% increase in the basic coefficient (for flow outside and normal to a single tube) when actual flow is normal to a bundle of staggered tubes. For this case the velocity to be used in entering the chart should be that corresponding to flow through the narrowest section between tubes. When flow is across a bundle of tubes which are in line some reduction in coefficient would be expected. Stoever suggests a 7.5% reduction while the recommendation of McAdams is equivalent to a 20% reduction. The latter recommendation has the double advantage of being conservative and of giving an answer numerically equal to the uncorrected value of h_o as taken from the chart. The value of velocity used in entering the chart should be, as for a staggered bundle, based on the narrowest space between tubes.

Many heat exchangers make use of baffles which direct the fluid alternately across the tube bundle from either direction. In such cases the film coefficient would be between the values for parallel and normal flow. An accurate evaluation of the coefficient would require detailed specification of flow conditions within a given exchanger, but as a first approximation a coefficient equal to 80% of the h_o for a single tube is suggested.

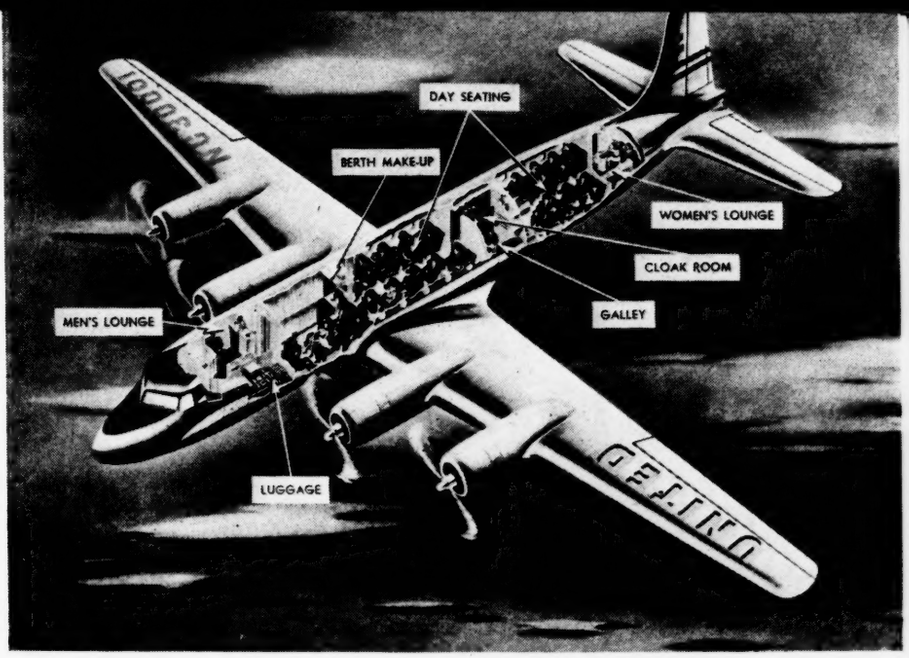
Apartment Dwellings Instead of Small Homes

Fewer than half of the families intending to buy or build a new home immediately after the war will be able to carry out their plans during the first post-war year, according to Irving W. Clark, chairman of the Residential Committee of The Producers' Council, Washington, D. C. Apartment dwellings, however, will be erected.

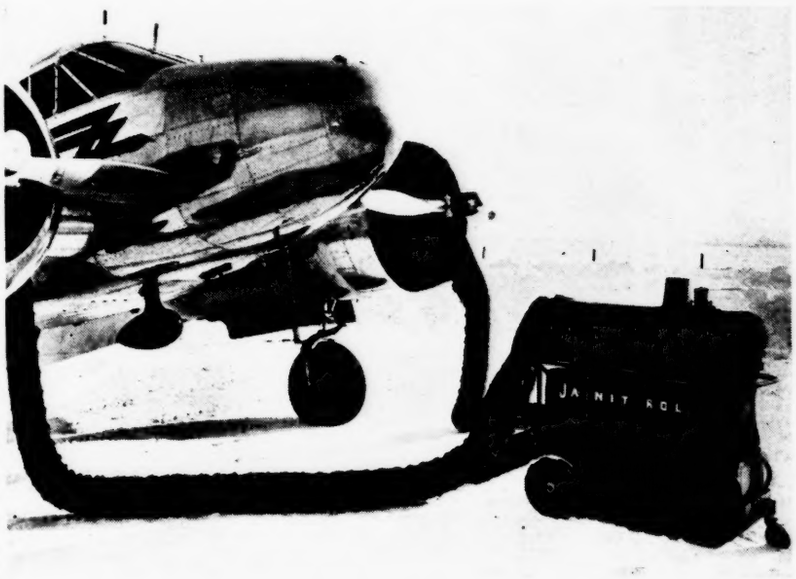
"Although the recent survey conducted by the Office of Civilian Requirements indicates that 650,000 non-farm families will be in the market for a new dwelling as soon as private home building can be resumed, a forecast by the Council's Market Analysis Committee shows that only about 350,000 new dwelling units will be built during the first year after the war." Although restrictions on the building of private dwellings probably will be relaxed within the next few months, the number of new homes constructed before the final end of the war will be relatively small, owing to the limited supply of many essential building products.

"Even though production of building materials and equipment can be resumed on a full scale soon after the final end of the war, the volume of new residential construction during the first 12 months after Japan is defeated will be limited because building contractors and home builders will need considerable time to reassemble their organizations and undertake extensive construction."

Picture Paragraphs

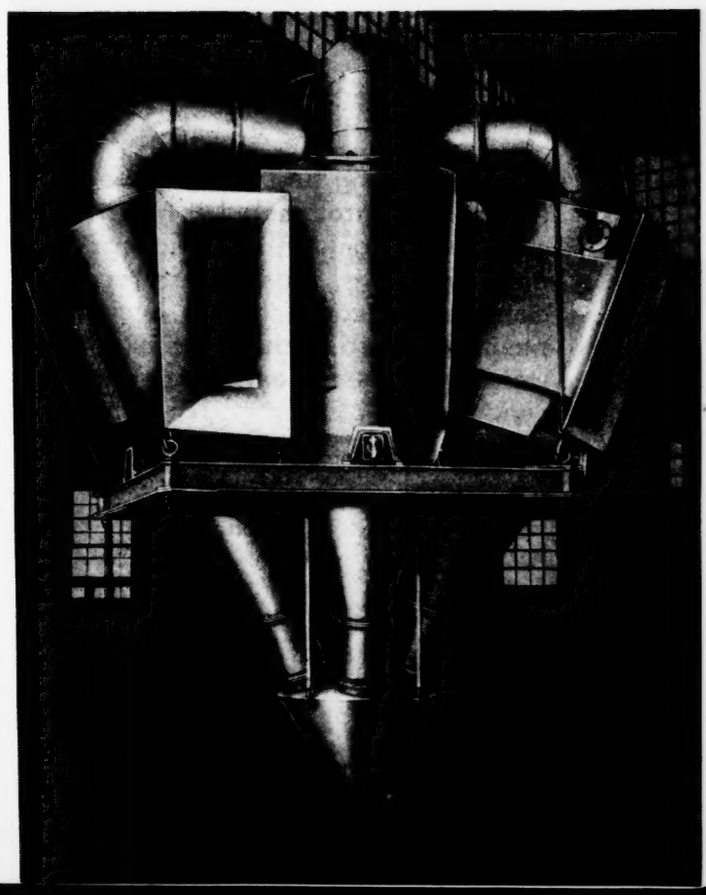


United Air Lines is investing $25,000,000 in a fleet of 50 4-engine Douglas transports, each to carry 35 or 50 passengers. They will fly at altitudes from 10,000 to 25,000 ft. The cabin, 64 ft long by 10 ft wide and over 7 ft high, will be pressurized to provide passenger comfort at the high altitudes. Even though outside temperatures of —50F may be reached, the cabin will be kept warm by internal combustion-type heaters.

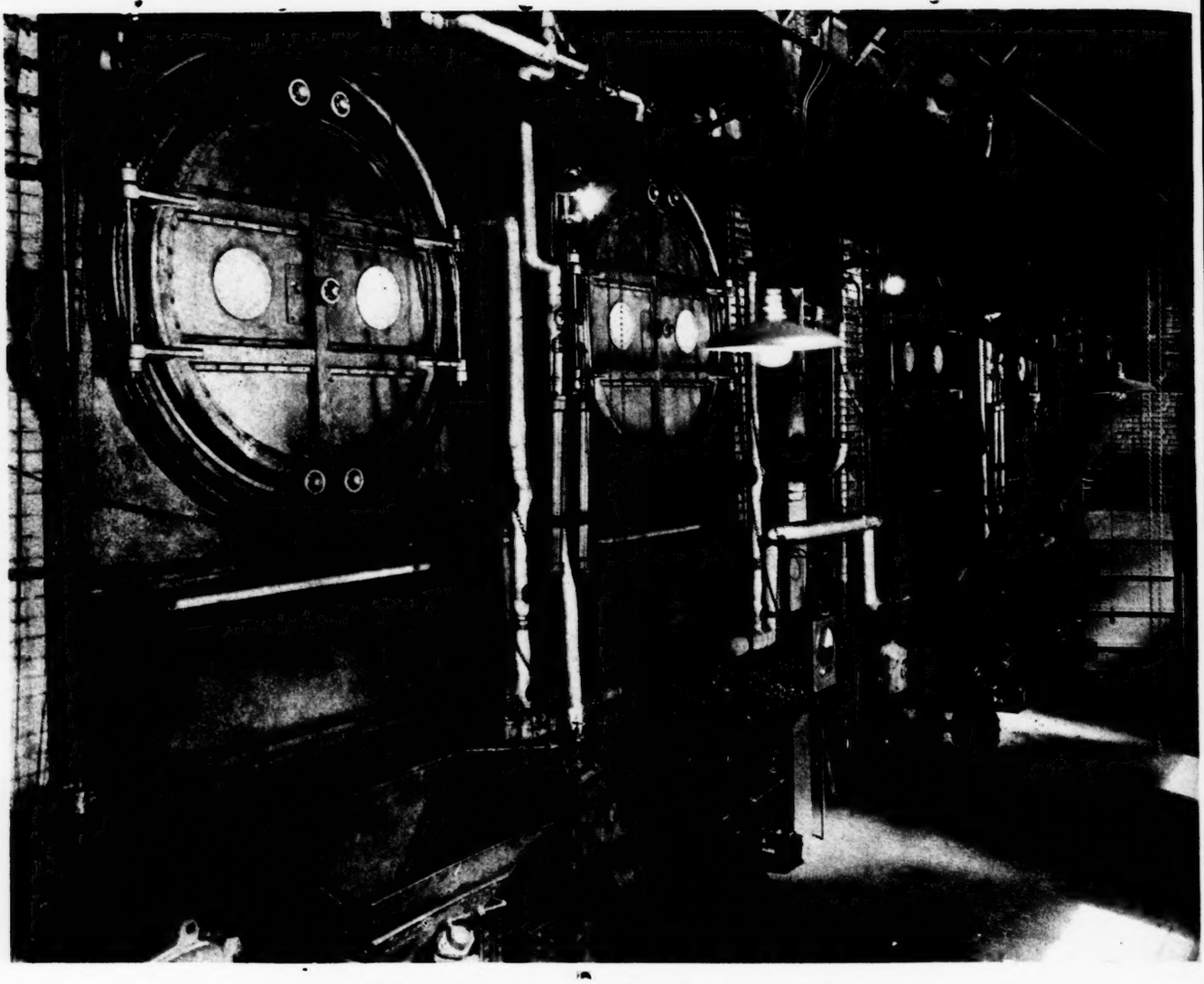


Airplane engines and cabins are now preheated by a portable heater developed by Surface Combustion Corp., which employs the same whirling flame principle of the Janitrol aircraft heater. It can also be applied to thaw frozen railroad switches, and for heating busses and passenger cars before they are placed in service.

Cyclone type dust collector, of stainless steel, made by Buell Engineering Co., for the collection of the catalyst in the production of 100-octane gasoline.



These buildings, part of the North Moreland apartment development in Shaker Heights, Ohio, are part of the 469 suites being constructed in that area equipped with Minneapolis-Honeywell personalized heating controls.



Four boilers with stokers are installed in the boiler room.

Central Heating Plant For Amherst College

F. N. HOLLINGSWORTH

Central heating has not only been profitable for dwelling groups, but it has shown a financial saving for Amherst College where the many buildings, widely scattered over a large campus, are connected to a central heating plant provided with four stoker fed boilers. Details of the system are described.

AMHERST College, alma mater of the late President Coolidge and many other eminent Americans, has a central heating system that serves 32 buildings widely scattered over an extensive campus. There are some interesting features about this heating system: High rate of condensate return by gravity; boilers over 17 years old; a low rate of coal consumption; exact, systematic records; conversion to concrete tunnels for new lines in place of older conduits.

Older buildings are served by mains and return lines laid in conduits, running in a loop up a hill. Newer buildings, including the $250,000 college commons, known as Valentine Hall, receive their heating steam and some process steam by means of a concrete tunnel 300 ft long, running under the Chemistry Building and Valentine Hall, where provision is made for future extension to new buildings. This tunnel, 6¼ ft by 5 ft wide, carries a 4-in. main and a 2-in. return. For the entire length, space is provided for inspection. The boiler house is at the foot of a hill on which many of the principal buildings are situated. Gravity return of condensate amounts to 90%.

Boiler Plant

Boiler plant equipment includes four International bituminous coal-burning boilers, each with 190 rated hp, now about 75% efficient. Each boiler has a

Combustion Jr., Type E, single retort stoker and steel T-suspension on cast iron columns, independent of brickwork. Steam is delivered at the boiler at 120 lb, and for campus mains is reduced to about 30 lb. Feedwater is preheated by a No. 9 Sims Company heater and is measured by a Venturi meter. Water level in the boilers is controlled by Bailey feed water regulators. Feedwater treatment is by Feedwater, Inc. Two of the boilers were installed in 1925 and the other two in 1926. Fuel is screened nut coal, with average annual tonnage under 3,500 tons.

Steam turbine booster fans, Clarage type S. P. No. 40, are used for forced draft, with a Clarage electric auxiliary fan for starting the boilers, in the absence of steam to operate the turbines. Manual controls are placed on a glass encased instrument board in the boiler room. Loads may be changed at quarter- and half-hour periods according to steam needs. Header valves have Pendleton controls and there are Walworth valves on the shunt system through the conduit loops running to the buildings. Most buildings have direct radiation.

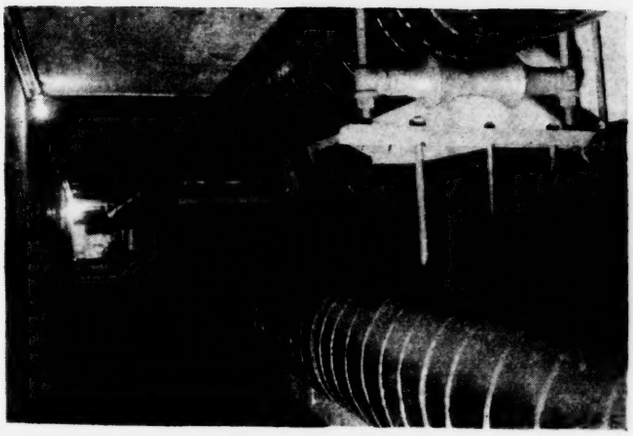
Steam Distribution Lines

Steam distribution to the older buildings is by conduit, with 8-in. insulated mains, laid in loops, The main loop covers the campus, goes up a hill to two buildings and branches to other buildings. The system can be reversed and steam sent around in the opposite direction if necessary. Each line has its own return, both high and low pressure.

Several of the newer buildings, including Valentine Hall, are served by the new tunnel line. Steel I-beams are used in the tunnel to support the main and return, and for lines that may be added. The tunnel main has 10-in. expansion joints, two double and one single, by American District Steam Company. A receiver tank takes the condensate from the return lines at 180F. Temperature in the tunnel averages 68F.

One conveyor system is used both for coal feed and ash disposal. A tripping device discharges coal at any hopper, while another trip enables the conveyor to take on ashes instead, discharging on the same track to an ash bin, from which it can empty into a waiting truck. A sprinkler system quenches the ash and prevents buckling of the buckets.

Central heating plant that serves the college.



A section of the new underground tunnel in which are the steam main and return.

Valentine Hall

Valentine Hall combines a college commons and a dormitory, and is unique in several respects. The dining halls serve 1000 or more students. The kitchen is in island form, with the principal cooking equipment on two sides of a huge ventilating stack leading to the roof. This stack is merged with the ceiling by plastering all over, down to the edges. Heating units, from the Herman Nelson Corporation, include four 1200 series horizontal hiJet unit heaters and six No. 503 DJ unit ventilators.

Fans for Valentine Hall heating and ventilating include one Sturtevant silent vane, Size 85 induction, and one exhaust unit, equal in size. American Filter Company washable filters with small exhaust fans are used in the kitchen exhaust and serving room ventilation. The building has 67,517 sq ft of direct radiation and 12,888 sq ft of indirect radiation. Dormitory rooms have standard Herman Nelson enclosed cabinet units.

The gallery portion of the swimming pool building is heated back of the seats by direct rediation. The pool level has two large low grilles at the far end of the tank, while ducts built inside the walls bring warm air up to the sills of the large side windows to be shot out by baffles over the pool.

In the basketball cage are grilles for bringing in warm air at floor level. Warm air from the floor is brought to the lower corners of the glass roof for deicing. Air is circulated through the various ducts by a Sturtevant multi-blade No. 9 double inlet centrifugal fan, with a capacity of 33,400 cfm, at ¾-in. static pressure.

ENGINEERING CREDITS

Architects for Valentine Hall, McKim, Mead & White, New York.
General contractors, E. J. Pinney Co., Inc., Springfield, Mass.
Heating and ventilating contractors, Valentine Hall, Holyoke Valve & Hydrant Co., Holyoke, Mass.
Consulting engineers, Lockood, Greene Co., New York.
Plumbing, Mutual Plumbing & Heating Co., Amherst, Mass.
Plant engineer, John Cambridge.

Rate of Oil Consumption Versus Time and Temperature

RICHARD BROWN

FUEL oil rationing brings to the minds of many the problem of using ration coupons to the best advantage. Without any technical analysis it is obvious that it is desirable to maintain a full tank of oil at all times.

The three accompanying charts hav been plotted from actual data of oil consumption and prorated to an annual consumption of 1000 gallons. The building from which the data were obtained is in Wellesley Hills, Mass.

To apply the figures on the charts to any oil consumption, multiply the figure taken from the chart by the number of thousands of gallons used in a season. Thus if 2,500 gallons were used, multiply by 2.5.

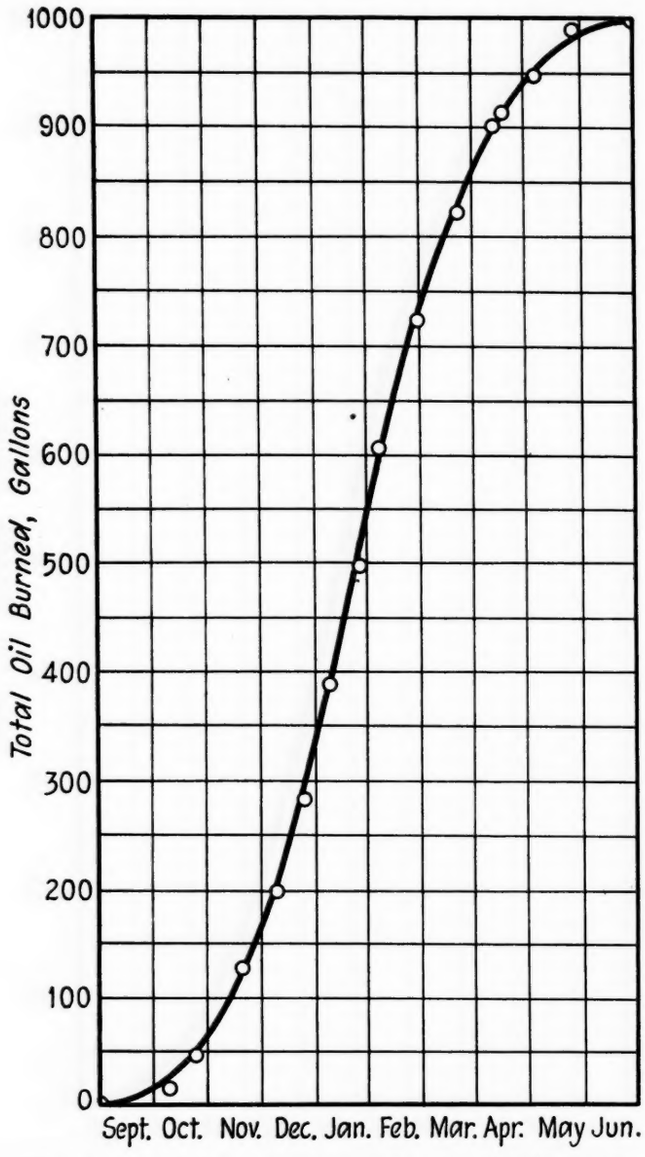


Fig. 1. Cumulative oil consumption for building and locality described.

Based on Fig. 1, Table 1 has been obtained showing the quantity of oil consumed during a heating season by months.

Since the table is based on a total consumption of 1,000 gallons, the percentage of the season's usage may be obtained by pointing off one decimal place in the table. For example 18.5% would be used in the month of February.

Fig. 2 shows the daily rate of oil consumption expressed as gallons per day. This curve is the tangent or first derivative of the curve in Fig. 1. The curve brings out the point that the daily rate of oil consumption varies considerably throughout a month. For example the rate on November 1 is 2.5 gallons per day and on December 1 it is 4.2 gallons per day. A study of the curve will show that one cannot consider the rate of fuel consumption to be practically

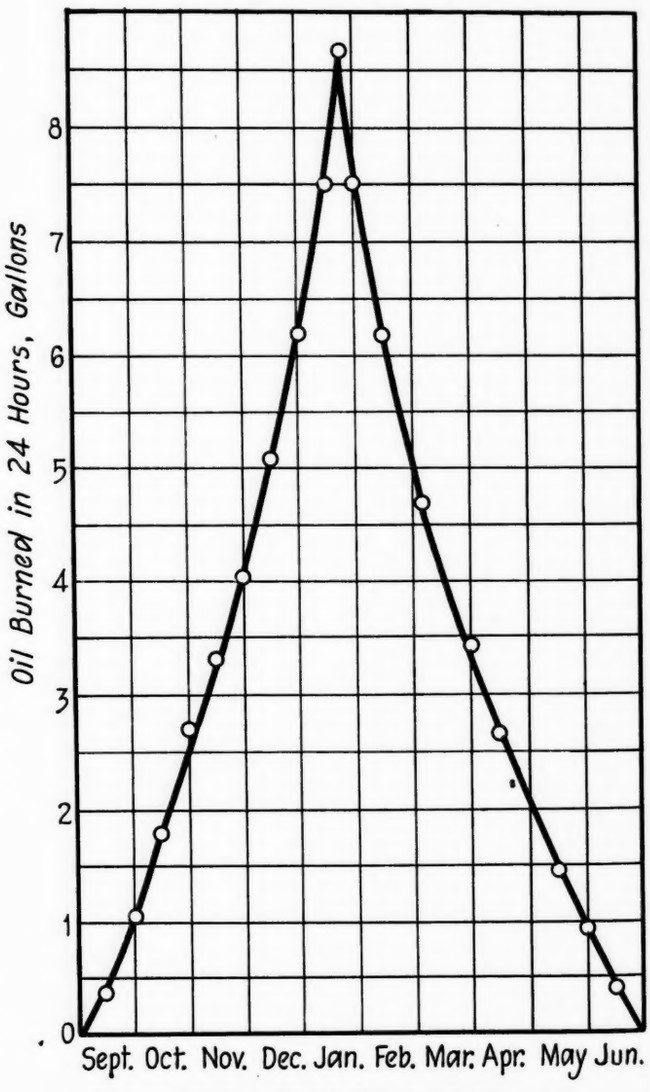


Fig. 2. Daily rate of oil consumption for building described.

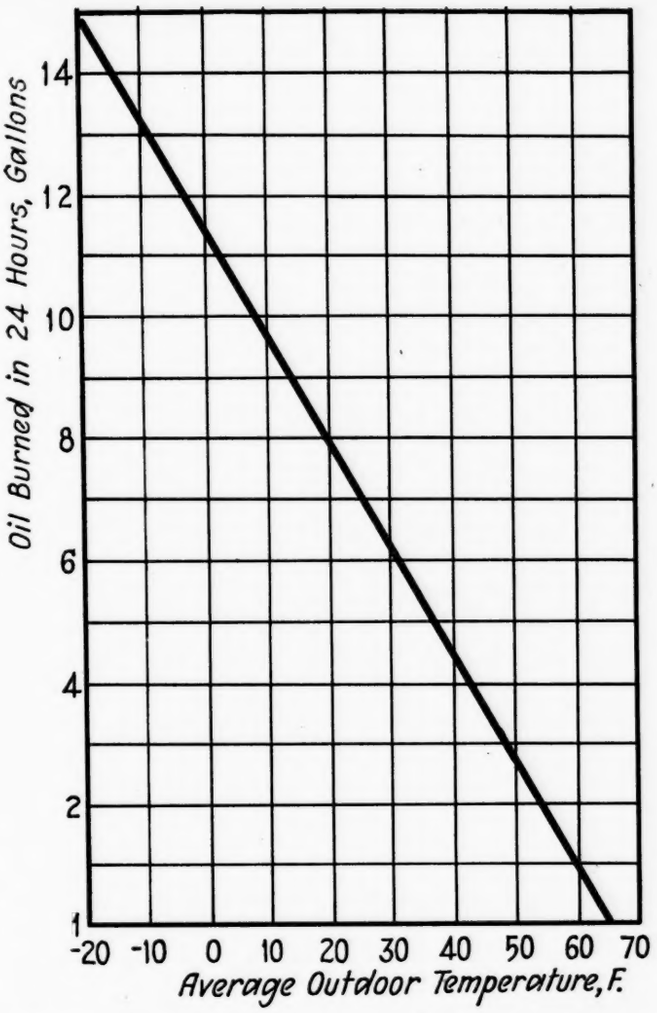


Fig. 3. Daily rate of oil consumption of building described with 70F inside, at various outside temperatures.

constant during the cold months. The rate of consumption comes to a maximum on about January 20. This date is also the half-way point in the season. The sharp peak in the rate curve is due to the fact that the tangent from curve Fig. 1 was not taken at several points around January 20. Had this been done the maximum would have been slightly rounded. The difference, however, is inconsequential, as will be seen from this discussion.

TABLE 1

Month	Gallons
September	13
October	57
November	100
December	155
January	230
February	185
March	123
April	80
May	45
June	12
Total	1000

Daily rates are average rates under widely varying conditions. This variation can be appreciated by considering a period of four or five days in February 1943, when temperatures varied from —15F to nearly 70F. Let us assume that during this period the average 24-hour temperature varied from —10F to 50F. From the chart, Fig. 3, the oil consumption would vary from 13.2 to 2.7 with an average of 7.8 gallons per day. From Fig. 2 the rate at this time is 7.00.

In addition to the wide variation in oil consumption due to change in temperature, there is a very considerable variation due to wind velocity. No accurate data on this variation are at hand, but it is of the order of two or three gallons per day on the scale of Fig. 3 between a day of average wind and of very high wind, at 30F, increasing as temperature decreases. This figure also varies considerably with the exposure of a building, and its tightness as well as insulation.

In conclusion it may be said that these charts give some average conditions from which to make approximations.

Packaged Fuel for Household Use

A new fuel, made from anthracite and bituminous fines held together by an asphalt binder, is to be produced for home use to help alleviate the present fuel shortage. It will be processed in the form of 3-in. cubes. Each will weigh a trifle more than a pound. A paper-wrapped package of six cubes will weigh 7½ pounds.

The plant which will make these cubes is sponsored by the War Production Board and endorsed by the Solid Fuels Administration. It will be financed by the Defense Plant Corporation, and will be erected and operated by the Blaw-Knox Company of Pittsburgh. Land, building and equipment will cost $400,000.

The new plant to be erected in Philadelphia, Pa., will have an annual capacity of 150,000 tons, and will use approximately 120,000 tons of anthracite each year. The balance, by weight, will be made up of bituminous coal and the asphalt binder. The distribution of the product to householders will be made through the regular retail outlets.

Blaw-Knox, a Pittsburgh engineering and steel fabricating concern, will operate the Philadelphia plant for the time being, although it is the intention of this company to manufacture processing equipment needed in the construction of similar plants elsewhere.

The ability of the Philadelphia plant to absorb 120,000 annual tons of anthracite fines will be of considerable benefit to the hard coal industry, which has been called upon to produce approximately 60,000,000 tons of domestic anthracite a year. The new scientifically prepared fuel can be burned efficiently without any changes in furnaces or stoves, and from extensive tests it is found to meet existing smoke abatement regulations.

Gasoline Piping and Storage

HARRY D. UNWIN

Mechanical Engineer, Albert Kahn Associated Architects and Engineers, Inc.

PART 3

The theoretical discussion of the fundamental Fanning equation for the flow of oils[1] and the development of formulas containing practical constants for the determination of pressure drop and horsepower also apply to the flow of gasoline. Due to the fact that we are dealing with a single liquid—gasoline—which has a viscosity similar to water (31 S.U.S.) considerable simplification can be attained in the solution of flow problems. For ready reference the basic Fanning equation is repeated as follows:

$$p = \frac{0.323 \times f \times s \times v^2 \times L}{D} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where p = pressure drop, pounds per square inch,
f = friction factor,
s = specific gravity of gasoline,
v = velocity of liquid, feet per second,
L = equivalent length of pipe, feet,
D = diameter of pipe, inches, and
c = a constant = 0.323

Since it is customary to specify the pressure drop in feet of gasoline the constant in the formula must be modified. Using the same roughness factor of 1.25 as applied to the fuel oil equation, the new constant (c) becomes

$$c = \frac{0.323 \times 1.25 \times 2.31}{s} = \frac{0.933}{s}$$

Substituting in equation (1), the specific gravity (S) cancels out and the formula becomes:—

$$p = \frac{0.933 \times f \times v^2 \times L}{D} \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

where p = pressure drop, feet of gasoline

Commercial and aviation gasolines range from 50 to 77 A.P.I. with corresponding specific gravities of 0.78 and 0.68, respectively. For a viscosity of 31 S.U.S., the kinematic viscosity (k) is 2.0. Table 1 tabulates the friction factor (f) for various rates of flow in different sizes of pipes and is derived from the formula for Reynolds number and the friction factor chart used for fuel oils. It can be shown that the Reynolds number is proportional to $\frac{DV}{k}$ and, therefore, the specific gravity can be eliminated entirely from both the friction factor and pressure drop calculations because pressure drop (p) is in feet of gasoline. However, specific gravity is necessary in the determination of horsepower, because the force required to move a body of liquid depends upon its weight; that is, it requires less power to deliver a given quantity of a liquid lighter than water than it does an equal quantity of water as shown by equation (1).

To simplify the calculations of pressure drop, Table 2 shows the relationship of p/f for pipe sizes of 1 to 4 in. with flow rates ranging from 5 to 150 gpm for steel pipe mains having an equivalent length of 100 feet. The pressure drop in feet of gasoline per 100 ft of pipe is therefore the product of the corresponding quantities in Tables 1 and 2 for a given flow rate and size of pipe. To determine the equivalent length of main (L) the resistance to flow of valves and fittings expressed in feet of pipe must be added to linear length of the main. See Table 3 on page 88.

TABLE 1.—FRICTION FACTORS FOR VARIOUS RATES OF FLOW AND PIPE SIZES

Flow, G.P.M.	Main Diameter, Inches						
	1	1¼	1½	2	2½	3	4
	Friction Factor (f)						
5	.0100	.0115	.0118	.0120	.0130	.0140	.0150
10	.0085	.0092	.0095	.0100	.0125	.0135	.0120
15	.0077	.0081	.0084	.0090	.0096	.0100	.0115
20	.0070	.0076	.0079	.0083	.0089	.0092	.0100
25	.0067	.0072	.0074	.0078	.0082	.0088	.0095
30		.0068	.0070	.0075	.0078	.0084	.0090
35		.0065	.0068	.0073	.0077	.0081	.0088
40		.0062	.0065	.0071	.0075	.0078	.0085
45		.0061	.0063	.0068	.0073	.0076	.0083
50			.0062	.0065	.0070	.0075	.0081
55			.0061	.0063	.0068	.0074	.0078
60			.0060	.0062	.0065	.0072	.0077
65				.0061	.0064	.0069	.0076
70				.0060	.0063	.0068	.0075
75				.0060	.0062	.0065	.0074
80				.0059	.0061	.0064	.0073
85				.0058	.0061	.0063	.0071
90				.0057	.0060	.0062	.0070
95				.0056	.0059	.0062	.0068
100				.0055	.0058	.0061	.0066
105					.0058	.0061	.0065
110					.0057	.0060	.0064
115					.0057	.0060	.0063
120					.0057	.0059	.0062
125					.0056	.0059	.0062
130					.0056	.0058	.0061
135					.0056	.0057	.0060
140					.0056	.0056	.0060
145					.0055	.0056	.0060
150					.0055	.0056	.0059

[1]See "Oil Piping—Its Design and Application," by Harry D. Unwin, Heating and Ventilating, November, 1944.

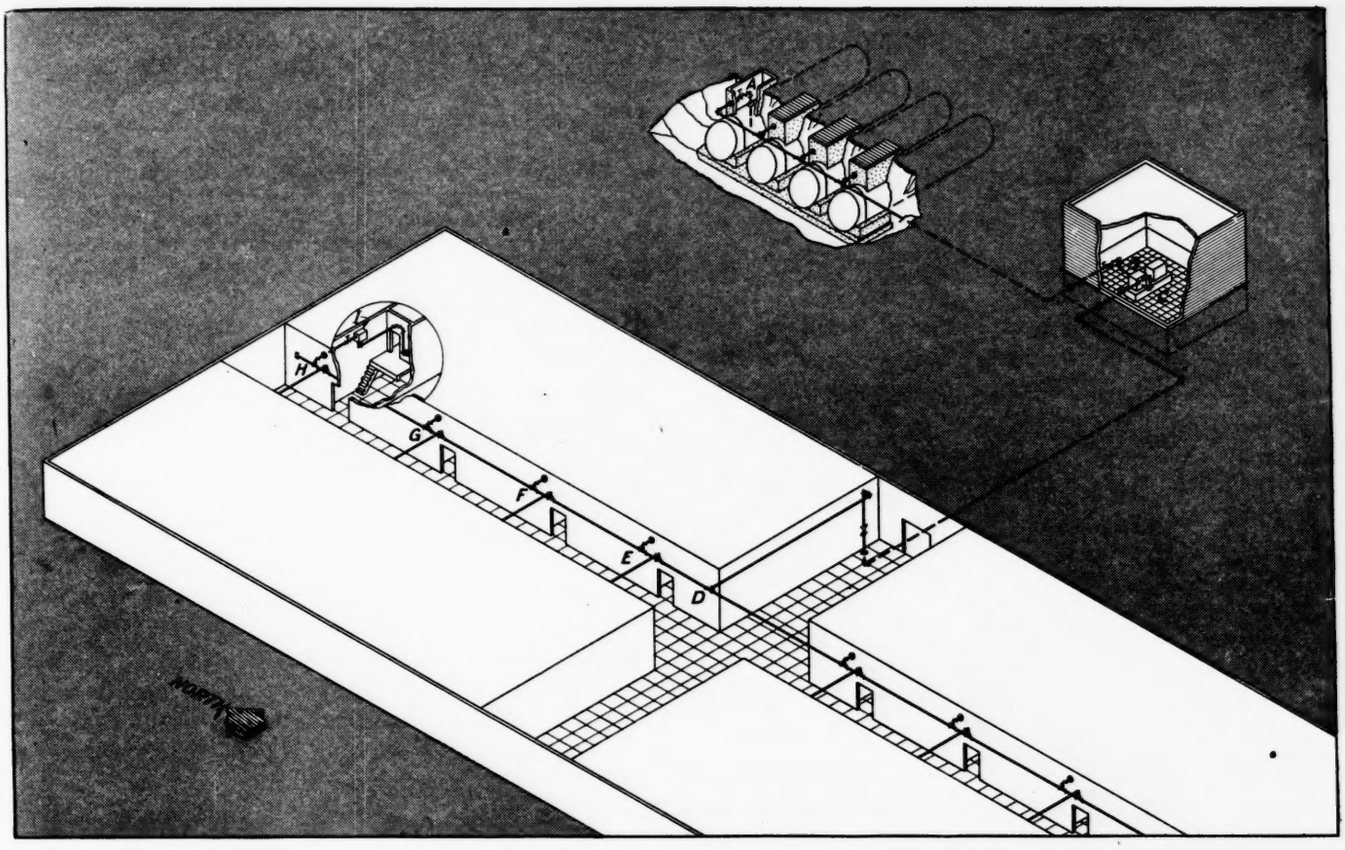


Fig. 7. Gasoline handling system for an aviation plant. Letters refer to the practical problem.

The horsepower required to drive delivery pumps may be calculated from the following equation:—

$$HP = \frac{W \times H}{33000 \times E} \quad \ldots\ldots (3)$$

$$= \frac{G \times H \times s}{1785} \quad \ldots\ldots (4)$$

where W = weight of water pumped per minute, pounds,
G = liquid pumped per minute, gallons,
H = total dynamic head in feet of liquid, including pipe friction and total height lifted from suction level, plus any excess terminal discharge pressure,
s = specific gravity, and
E = efficiency of pump, drive and motor = 45%

In the case of a hydraulic delivery system the required water pressure expressed in pounds per square inch is equal to $\frac{H \times s}{2.31}$

Practical Application

Problem. An aviation engine plant, approximately at sea level, and having 32 test cells, requires 2500 lb per hr of 100 octane gasoline per engine when running full load. The 100 octane gasoline has a specific gravity of 0.70 and a vapor pressure (Reid) of 7.0 lb absolute with a corresponding bubble point of 8.5 lb at storage temperature in the underground tanks. It is estimated that the number of engines under full load at any one time may be as high as 12. Minimum bury over the tanks is 3 ft. Four 10 ft diameter tanks have been purchased for underground storage. The layout is as shown in Fig. 7. Determine (a) the elevation of the pump suction if rotary positive displacement pumps are used; (b) the size of the distribution mains, and (3) complete pump specifications.

TABLE 2.—VALUES OF RATIO P/f PER 100 FT. OF PIPE IN FEET OF GASOLINE FOR VARIOUS RATES OF FLOW AND PIPE SIZES

Flow, G.P.M.	Main Diameter, Inches						
	1	1¼	1½	2	2½	3	4
	Values of P/f						
5	320	83	37	10	4	1	—
10	1215	297	148	45	17	6	1
15	2790	690	332	88	38	13	3
20	4870	1250	556	162	64	25	6
25	7680	1970	880	260	109	37	9
30		2770	1285	378	151	51	13
35		3795	1750	490	200	69	18
40		5000	2300	658	276	88	23
45		6230	2920	832	340	122	30
50			3620	1070	438	147	39
55			4380	1260	510	173	45
60			5120	1465	605	206	52
65				1750	710	240	62
70				2030	835	274	75
75				2340	945	319	83
80				2610	1105	371	93
85				3000	1220	410	107
90				3330	1360	463	123
95				3740	1530	510	132
100				4180	1700	563	145
105					1860	626	163
110					2040	687	179
115					2230	755	195
120					2430	815	214
125					2660	886	222
130					2870	963	250
135					3060	1040	270
140					3310	1110	290
145					3550	1190	312
150					3780	1280	336

Analysis of Problems. The first step is to determine the quantity of gasoline to be handled:

Weight of gasoline = 8.33 (lb water per gal) × 0.70
= 5.83 lb per gal

Maximum consumption per engine

$$= \frac{\text{2500 lb per hr.}}{\text{60 min per hr} \times \text{5.83 lb per gal}} = 7.15 \text{ gpm}$$

Since 12 engines may run at full load simultaneously it is apparent from the layout that the 12 cells at the north end of the plant—6 on each side of the main aisle—will result in the maximum flow to the most remote cells; and furthermore the arrangement of cells shows that each constant head tank outside the control rooms will supply two engines. Therefore, each branch main to this head tank must have a capacity of 7.15 x 2 or 14.3 gpm and the total quantity of gasoline to be delivered by the pump will be 12 x 7.15 = 85.8 gpm.

Determination of Suction Conditions. The bottom of the storage tank will be 10 ft (diameter) plus 3 ft bury, or 13 feet below grade. This will necessitate the lowering of the pump room floor so that the suction created by the pump will not exceed the allowable limit.

Atmospheric pressure = (14.7 × 2.31) ÷ 0.7
= 48.7 ft of gasoline

Vapor pressure = (8.5 × 2.31) ÷ 0.7
= 28.1 ft of gasoline

Available suction lift ..... = 20.1 ft of gasoline
Allowance for pump operation .... = 8.0 ft of gasoline

Permissible suction lift ..... = 12.1 ft of gasoline

Since this includes both vertical lift and friction loss in the suction line it is evident that the pump room must be located several feet below grade. Assuming a 3 in. suction line from the furthest tank to the pump the equivalent length of pipe is:—

Linear feet of 3 in. pipe (A-B)	150
5 elbows at 8 ft (Table 3)	40
3 tees at 16 ft	48
1 check valve	10
2 gate valves or plug cocks at 2.5 ft	5
1 strainer (assumed)	5
Total equivalent length	258 feet

The friction factor (f) from Table 1 corresponding to 85 gpm and 3 in. pipe is 0.0063 and the pressure drop (P ÷ f) for the same flow (Table 2) is 410 feet of gasoline. Therefore, the actual friction loss in the suction line is

$$0.0063 \times 410 \times \frac{258}{100} = 6.7 \text{ feet of gasoline}$$

TABLE 3.—RESISTANCE TO FLOW OF GASOLINE IN VALVES AND FITTINGS

Pipe Dia., Inches	Type of Fitting					
	Elbow	Tee	Check Valve	Gate Valve	Angle Valve	Globe Valve
	Equivalent Length of Straight Pipe, Feet					
1	3	6	3	0.8	4	9
1½	4	8	5	1.2	6	12
2	5	10	7	1.7	9	15
2½	6	12	8	2.1	11	18
3	8	16	10	2.5	13	24
4	10	20	13	3.3	17	30
6	15	30	20	5.0	25	45
8	20	40	27	6.7	34	60
Approx. Pipe Diameters	30	60	40	1.0	50	90

The pump suction must therefore be 12.1 — 6.7 = 5.4 feet above the bottom of the storage tank or 13 — 5.4 = 7.8 feet below grade, which is at approximately the centerline of the tanks.

Since this is excessive for the practical location of the pump room floor, assume the suction line as 4 in. pipe, and the friction loss from A to B will be 2.2 feet of gasoline. In this case the pump suction must be 12.1 — 2.2 = 9.9 feet above the bottom of the tank or 13.0 — 9.9 = 3.3 feet below grade. Allowing 15 in. from the pump inlet to the floor for base and pump dimensions, the pump room floor should be approximately 4 ft, 6 in. below grade. It is therefore decided to use a 4 ft suction line and locate the pump room floor accordingly.

Determination of Pumping Head. A similar procedure for determining the pressure drop in the delivery system due to friction is used as for the calculation of friction loss in the suction main. As the total suction lift is equal to the sum of the vertical lift plus the resistance due to friction, so the pumping head is equal to the height to which the liquid must be lifted plus the friction loss, all in terms of feet of gasoline. There being no restriction to the friction head except size of motor to drive the pump, it is often desirable to balance the initial cost of large mains against the power consumption required to overcome the increased head due to smaller pipes. This is particularly true when pumps are operated continuously. It has been found that a velocity of flow less than 10 feet per second results in an economical pipe size, although for short runs, higher velocities are sometimes used.

Referring to Fig. 7 assume pipe sizes for the variouss sections and compute the pressure drop in each section. Since the east and west branches to the constant level tanks are so close together they may be taken as at the same point. The computed data are tabulated at the left.

Section	Flow, Gpm	Dia., In.	Length, Feet	Fittings, Feet	Equiv. Length, Feet	f	p/f	p
H-I	14.3	1	40	4	44	0.0077	2790	9.5
G-H	28.6	1½	60	16	76	0.0070	1285	6.9
F-G	57.2	2	60	20	80	0.0062	1465	7.3
E-F	85.8	2½	60	24	84	0.0061	1220	6.3
D-E	85.8	2½	35	24	59	0.0061	1220	4.4
C-D	85.8	3	415	71	486	0.0063	410	12.6

Total friction head in feet of gasoline..... = 47.0
Elevation of constant level tank above pump (ft)..... = 38.0

Total maximum pumping head in feet of gasoline..... = 85.0

Determination of Horsepower. The total dynamic head against

(Continued on page 119)

New Developments in Washington

Government Lists Types of Users to Receive Freon-12; Coal and Oil Prospects for Heating Considered Critical.

LORING F. OVERMAN

AS this column went to press there were indications that the first or second week in March would bring one of the most encouraging bits of news the air conditioning industry has heard in months—plans for release of important quantities of Freon-12 to classes of users who have been denied delivery of this refrigerant for more than a year.

By another amendment of Conservation Order M-28, the General Industrial Equipment Division of WPB was planning to announce procedures for the release of between 200,000 and 250,000 pounds of Freon-12 on a "while the supply lasts" basis to users named in the Order under List A, as follows:

LIST A—SYSTEMS FOR WHICH NO DELIVERIES ARE PERMITTED

Air conditioning systems. Any system, of any size operated or installed for the purpose of lowering the temperature and/or humidity of air in any building, room or other enclosure used as, or located in any of the following:

Amusement parks
Animal hospitals
Auditoriums
Ballrooms, dancing studios and dance halls
Bank and loan associations
Bars, cocktail lounges, and beer parlors
Bowling alleys
Concert halls
Funeral parlors
Golf clubs, country clubs, athletic clubs, and all other clubs and club houses
Hotels and apartment houses
Moving picture houses
Night clubs
Office buildings and offices, public or private
Railway, streetcar and bus stations and terminals
Residential buildings and dwellings of all kinds
Restaurants, cafeterias, and other places selling meats, food or beverages
Schools
Service establishments, such as laundries, cleaners and dyers, tailor shops, barber shops, "beauty" parlors, automobile sales and service shops, and repair shops of all kinds
Skating rinks
Stores, selling any kind of products, material or merchandise, at retail or wholesale (excluding manufacturing establishments)
Studios of all kinds
Theaters

This list does not include (i) any such system used primarily to air condition a building, room or other enclosure used chiefly for purposes not listed above, or (ii) any system designed, necessary and used, in substantial part, for the refrigeration and storage or processing of food, ice, or other materials or products, necessary to life or health, or to be delivered to the Army, Navy, Maritime Commission or War Shipping Administration, and requiring refrigeration temperature control, or freedom from dust or other impurities.

Refrigeration systems.

Skating rink systems
Refrigeration systems solely for storing or dispensing carbonated or malt beverages

Details Not Settled

While plans for the release of certain quantities of F-12 had progressed to a point warranting announcement in advance of actual amendment of Order M-28, details of the plan are subject to change up to the moment the amendment is printed in Washington's Federal Register. The usual procedure, when WPB Orders are to be changed, is to decide on a final version, which is placed "in five day circulation" among all agencies, including the military, who are likely to be concerned with the proposed revisions. If no changes are requested by the affected agencies during the five-day period, the order proceeds through "clearance" to the Federal Register, where its appearance serves official notice that it is in effect.

Details involved in the current amending of Order M-28 are chiefly concerned with the amount of F-12 to be made available, and the method of distributing it to applicants. The administrators of Order M-28 would like to be freed of the voluminous detail of handling each application as an individual appeal. They recognize, however, the logic of making initial distribution to those experiencing the greatest hardship, those whose operations are related to the war effort, and so on down the line. There are indications that the distribution will not be made on an individual appeal basis, but that some yardstick of relative importance of the applicant's need will be provided.

A-C IAC Meet Deferred

With the exception of the F-12 angle, February in Washington developed little of direct interest to the industry, a conclusion verified by postponement of a scheduled meeting of the General Refrigeration and Air-Conditioning Industry Advisory Committee from February 14 to March 14. As usual, however, there was enough general action in the Capital to keep all eyes focussed there for hints regarding what the next steps may be. And each indirect action had its effect directly, one way or another, on the heating and air-conditioning industry.

Civilians Take Back Seat

In some ways a grim change is noticeable in some Washington government offices—a change that proves mighty embarrassing for businessmen who arrive with brief cases jammed with statistics intended to prove that the bars should be relaxed a bit to encourage civilian production. The applicants are shown into the office of some executive "loaned" to government by private business—just the kind of a man who should be expected to listen sympathetically to the applicant's proposal.

In an increasing number of instances, the businessman-in-government will veto the proposal, suggesting that the applicant file the data for presentation when the military situation has clarified. If the applicant is too insistent, he may be told to sit down and listen to the whole story—that the government man has just lost a son at Iwo; that his daughter's husband is missing over Germany; perhaps that a brother on a certain

submarine hasn't been heard from for three months.

While it may be unfair for those in a position to make business decisions to base them upon their personal relation to the war, it is nevertheless a fact that mounting casualty lists, thousands of them affecting Washington officials, are making them take this war very seriously. This attitude, among men who have experienced personal losses, is transmitted to other officials whose sons are under fire, with the result that official Washington is saying, "Let's finish this war now, at the earliest possible moment. As far as I am concerned, civilian production can wait."

Fuel Crisis Looms

While we may decry as short-sighted the increasing tendency among government officials to give the military precedence over all civilian projects, it might also be desirable if this same degree of personal war-consciousness could be experienced more generally throughout the country.

For example, what may happen on April 1 if the coal miners and operators fail again to sign a mutually satisfactory contract, is causing no little concern in Washington. A work stoppage, regarded now as not at all unlikely, would further aggravate an already dire steel shortage—with ramifications that would be felt all the way to the front lines. The contract deadline would find steel mills with three million tons of unfilled first-quarter orders. These will have priority over second-quarter estimated requirements, themselves exceeding supply by another three million tons.

The War Production Board has urged both miners and operators to speed consideration of their 1946 contract. Both are already meeting in Washington, but observers report that viewpoints are again as widely separated as they were preceding previous annual showdowns. There is one important difference—the country's reserve fuel supplies are lower than during previous strikes or threats.

Estimated requirements of soft coal for 1945 are 620 million tons. Production for the year was estimated on January 1 at 580 million tons, and weather troubles since then have cut into this latter figure. This leaves a deficit of at least 40 millions tons—about the size of the Nation's estimated March 1 stockpile. Utilization of coal is reported at 1.8 million tons daily; thus the stockpile would keep industry going for less than a month.

As the deadline approaches, official Washington realizes that its bargaining power is at a low ebb. It is not unlikely that the miners and their leaders have reached the same conclusion. The outcome will doubtless prove interesting.

Conservation Moves

In the meantime, Washington has made three moves interpreted as being partly to conserve coal and primarily to condition the public for further drastic action. These moves were Justice Byrnes' ban against race tracks, the brownout of out-door lighting, and the amusement curfew. It is interesting to note that a one-day work stoppage in the mines would wipe out the 2 million ton coal saving estimated for the brownout regulation.

Petroleum, Too

With future coal supplies so dependent upon what John L. Lewis calls "Our historic and automatic policy of no contract, no work," the outlook regarding petroleum products and natural gas is also important. The current supply situation is reported as extremely critical because of transportation congestion on the East Coast and because of record-breaking military demands. Following are some of the steps that have been taken to maintain present levels and plan for the future:

1. The Petroleum Administration for War on February 20 called upon the oil industry to reach a new all-time record production rate of 5,118,760 barrels daily of all petroleum liquids during March. The certified rate for February was 5,074,850 barrels.

2. The Office of Defense Transportation on February 12 requested operators of the Nation's 16,000 over-the-road petroleum tank trucks to put them to work a minimum of 130 hours a week. In making its request, ODT reminded owners of such equipment that the transportation agency has power to direct the manner in which petroleum trucks may be operated and that it may order the leasing of equipment not fully utilized. At the same time, shippers of petroleum products were asked to notify ODT of the refusal of any concern to lease idle or partially-idle tank trucks.

3. The Petroleum Administration for War on February 22 amended Petroleum Distribution Order No. 13 to require approval by PAW before any kind of fuel oil can be used in commercial or industrial space heaters installed after February 26, 1945, and which singly or in combination burn 10,000 or more gallons a year.

It was explained that in recent months manufacturers have developed large space heaters that are being installed in warehouses and other large commercial establishments to heat large areas. The new requirement is designed to control more closely the large supply of oil that is beginning to be diverted into channels that previously had not used this type of fuel.

4. Three steps to conserve propane, in increasing demand as a fuel in war plans, have been taken by the Petroleum Administration for War:

(a) Applications for new installations of equipment using propane will not be approved.

(b) Applications for the installation of equipment used to connect propane-using facilities with existing liquefied petroleum gas systems will not be approved

(c) Liquefied petroleum gas dealers must now apply to PAW for authorization to install or reinstall any type of used L-P gas equipment for purposes other than maintenance and repair. Previously dealers were permitted to reinstall gas equipment that had been installed and in actual use prior to April 1, 1942, and which was removed from use after that date.

The first two of the three steps taken by PAW apply throughout the country except in the West Coast States, where problems of propane supply and transportation are less acute. The third step is applicable throughout the country. Similar measures to conserve butane are already in effect.

5. Anticipating next season's fuel needs, the WPB Office of War Utilities authorized, during February, pipeline extension and improvement projects designed to deliver an additional 110,000,000 cubic feet of gas into the Appalachian area by November 1, 1945.

"Spot" Order Amended

Although most current action in Washington is keyed to military needs and manpower shortages, there is evidence that some of the thinking still takes the future into consideration. Case in point is the amendment, on February 23, of Priorities Regulation No. 25, the order governing operation of the spot authorization program. Although the spot authorization program is in virtually a state of suspension, with the exception of projects authorized during 1944, the new amendment will make the order more flexible when civilian production can again be resumed.

Under the original spot authorization rules, only those products that were subject to Limitation or Conservation orders were eligible for spot authorizations. Under the amendment it will be possible for WPB to grant spot production for a larger number of civilian type items.

NEWS OF THE MONTH

ASHVE Holds 51st Annual Convention

More than 600 persons attended the 51st annual meeting of the American Society of Heating and Ventilating Engineers held at the Hotel Statler, Boston, Mass., January 22-24. Fourteen papers were presented at four technical sessions. A special program was arranged for the ladies.

In "Studies of the Mechanism of Solution of CO_2 in Condensates Formed in Steam Heating Systems of Buildings," by Leo F. Collins, Consulting Engineer, Detroit, Mich., it was pointed out that the highest CO_2 concentration persists at the end of the steam path. Also, where a one-pipe system has operated for long periods, the CO_2 in the condensate as it emerges from the condenser is apt to be much greater than that of the incoming steam.

D. S. McKinney, Assistant Professor of Chemistry, Carnegie Institute of Technology, Pittsburgh; J. J. McGovern, society research fellow, C.I.T.; C. W. Young, teaching assistant at C.I.T.; and L. F. Collins, Detroit, Mich., presented a paper on "Preventing the Solution of CO_2 in Condensates by Venting of the Vapor Space of Steam Heating Equipment." Where the steam contains a large amount of CO_2, it is important that some thought be given to venting to prevent a condensate containing concentrations of CO_2.

In their paper on "Summer Weather Data and Sol-Air Temperature," C. O. Mackey, Professor of Heat Power Engineering, Cornell University, and E. B. Watson, Assistant Professor of Engineering Materials, Cornell University, Ithaca, N. Y., tabulated data on New York City and Lincoln, Neb. Equations are given for sol-air temperatures, and examples are presented to illustrate how to use the equations in specific problems.

W. E. Crowell, Section Head, Altitude Chamber Structures Department, Curtiss-Wright Corp., Buffalo, N. Y., presented a paper on "Altitude Chamber for Study of Heating and Air Conditioning Problems." He described how the altitude chamber can be used for some of the problems that develop in flight at high altitudes. He touched on the problems of heating, and pressurized cabins.

Several extensive tables on the thermodynamic properties of moist air at standard atmospheric pressure are contained in the paper on "Thermodynamic Properties of Moist Air," by John A. Goff, Dean, Town Scientific School, University of Pennsylvania, and S. Gratch, Assistant Instructor in Mechanical Engineering at that school. The tables presented are for the range —160F to 200F.

A method of solving problems dealing with coil rating and performance was presented in the paper on "Air Cooling Coil Problems and Their Solutions," by Lawrence G. Seigel, Instructor in Mechanical Engineering, Case School of Applied Science. Although the author presented in 1938 a paper on the basis for this method of computation, extensive research has shown the flexibility of the method for various conditions of coil performance.

R. S. Dill, Chief, Heat Transfer Section, National Bureau of Standards, Washington, D. C., prepared a paper on "A Survey of Testing Methods and Rating Limits for Domestic Heating Devices." He tabulated the most important features of the various codes and called attention to special requirements of each.

"Radiation Corrections for Basic Constants Used in the Design of All Types of Heating Systems" were described by B. F. Raber, Professor of Mechanical Engineering, and F. W. Hutchinson, Associate Professor of Mechanical Engineering, both of the University of California. Actually it is the third progress report of research conducted at the university.

The importance of adequate ventilation for all mining operations was discussed by D. Harrington, Chief, Health and Safety Branch, Bureau of Mines, in his paper on "Mine Ventilation and its Relation to Health and Safety."

"Tobacco Smoke Control—a Preliminary Study," by Charles S. Leopold, Consulting Engineer, Philadelphia, is a description of a test method employed in studying tobacco smoke conditions in Madison Square Garden, New York City.

To determine the decibel values or sound output rating of ventilating fans, the Navy Department designed a test room where large fans could be tested. Description of the test room and results of some tests are contained in the paper "Noise Ratings of Ventilating Fans," by W. H. Hoppmann, 2nd, Senior Mechanical Engineer, and Fred Lager, Associate Mechanical Engineer, New York Navy Yard.

The new officers of the society are President, C.-E. A. Winslow; 1st Vice-President, Alfred J. Offner; 2nd Vice-President, W. A. Russell; Treasurer, L. P. Saunders.

Discusses Heat Pump

LEHIGH, PA. — The heat pump was foreseen here as being a definite commercial possibility in the near future and was declared to offer fuel economy and efficiency for surpassing present heating systems. Report on the process was given by G. K. Marshall, General Electric air conditioning engineer, who said that several installations for this type system were made before the war and are still operating satisfactorily. He spoke before the Lehigh Valley section, American Institute of Electrical Engineers.

Mr. Marshall said that at about 52F outdoor temperature, the heat pump will provide four times as much heat as is available in the electricity consumed. Even allowing 15% for transmission losses between the generating station and the home, it will deliver at the 52F outdoor condition 116% of the heat that was in the fuel burned for supplying energy.

In regard to cost of operation, Mr. Marshall said, "Using power at 1 cent per kilowatt hour, the heat pump would have the same operating cost as coal at $14 per ton, oil at 10 cents per gallon, manufactured gas at 40 cents per thousand cubic feet or natural gas at 80 cents per thousand cubic feet. This is approximately the picture as it exists today with a heat pump constructed with general purpose refrigeration equipment in a climate such as Pittsburgh and drawing its evaporator heat from the outdoor air. But it can be improved by further development of the equipment or by finding a higher temperature source of heat than outdoor air."

Contractors Elect Breer

LOS ANGELES—Louis C. Breer, Los Angeles, was elected president of the Heating, Piping and Air Conditioning Contractors Association of Southern California, Inc., here at a meeting of the Association held January 9. Other officers elected were: Henry Schleuter, vice-president, and F. C. Schilling, secretary. H. G. Cary was re-elected as treasurer. Members of the board of directors are: Louis C. Breer, F. C. Schilling, H. C. Cary, Henry Schleuter, Claude Hickman, F. D. Reed, J. Herman, Jr., William Nies and Ray Younger.

Mortensen to Receive Lamme Medal

NEW YORK—Soren H. Mortensen, chief electrical engineer of the Allis-Chalmers Manufacturing Company, Milwaukee, Wis., will receive the 1944 Lamme Medal of the American Institute of Electrical Engineers "for his pioneer work in the development of self-starting synchronous motors and for his contributions to the development of large hydraulic and steam turbine driven generators".

Mr. Mortensen was born in Eskelund, Denmark, on November 4, 1878. He received the degree of bachelor of arts from the Ribe Latin School in Denmark in 1916 and the degrees of electrical engineer and mechanical engineer from the Polytechnicum of Mittweida, Germany, in 1902. He received the honorary degree of doctor of engineering from the Illinois Institute of Technology in 1944.

He has received a number of patents on various design features in motors and generators, and has made numerous contributions to the literature on electric machinery.

Contest for Papers on Welding

CLEVELAND, OHIO—In order to encourage the preparation of outstanding papers dealing with resistance welding subjects, the Resistance Welder Manufacturers Association, Philadelphia, Pa., has for several years conducted a prize contest, the awards for which are announced annually at the fall meeting of the American Welding Society. The scope of this contest has recently been increased, bringing the total amount of the awards up to $1000, as follows:

One prize of $500 for the best paper emanating from an industrial source, consulting engineer, government laboratory, or the like, in which the major portion of the subject matter is concerned with design for resistance welding. This includes design of component parts to accomplish the maximum economy and welding quality and also details of procedure, work preparation and work handling, etc.

Two prizes of $200 each will be awarded to the authors of two papers, not primarily concerned with design, which, in the judgment of the Board of Awards, are the greatest original contributions to the advancement and use of resistance welding. One of these two prizes shall go to the best paper emanating from a university source—that is, either an instructor, student, or research fellow at a recognized university. The second shall be awarded for the best paper emanating from an industrial source.

A fourth prize of $100 will be awarded to the author of the best remaining paper, which may fall in any of the three groups mentioned.

The contest is open to anyone, without restriction, from the United States, its possessions and Canada. It is also open to any member of the American Welding Society in any grade from any place in the world. The contest is considered as having opened Sept. 1, 1944, and will close on midnight, July 31, 1945. Papers which are to be presented at the Annual Meeting of the American Welding Society in October may also be entered in this contest, in which case a draft or copy of the paper must be filed with the American Welding Society not later than July 31, 1945.

A. C. for Army Hospitals

BOSTON—After vigorous protests to the War Department by Congressman Philip J. Philbin of the Third Massachusetts District, following a tour of New England army hospitals, the War Department has moved to provide them with air conditioning, and Congressman Philbin has so informed his Massachusetts constitutents. Air conditioning will be installed in the surgical suites, X-ray clinics and recovery wards of army hospitals in the Boston area, those benefiting being Cushing General at Framingham, Lovell General at Fort Devens and the Waltham Regional Hospital, formerly known as the Boston Area General Hospital.

New England is outside the thermal zone where the army installs air conditioning, but army regulations have been relaxed by Lieut.-Gen. Somervell to permit installation.

New ASRE Section Formed

WATERBURY — A Connecticut Valley section of the American Society of Refrigerating Engineers has been formed to include members from western Massachusetts and Connecticut north of Bridgeport. Officers have been elected as follows: chairman, A. W. Towson, Worthington Pump & Machinery Corp., Holyoke, Mass.; vice-chairman, R. H. Tull, Westinghouse Electric & Mfg. Co., E. Springfield, Mass.; vice-chairman, Mert Allen, American Brass Co., Waterbury, Conn.; secretary, John K. Campbell, Bush Mfg. Co., Hartford, Conn.; treasurer, Joseph Simons, Joseph Simons Co., Hartford; publicity committee, Stanley R. Osborne, chairman, Chase Brass & Copper Co., Waterbury; Carle C. Payson, C. P. Payson Co., Springfield; Bertram Butler, Bush Mfg. Co., Hartford.

Meetings are scheduled for Springfield and Hartford, alternating between the two cities each month.

At the recent meeting held February 15 at the Hotel Sheraton in Springfield, R. J. Thompson, Kinetic Chemicals Inc., Wilmington, Del., discussed "Freon Refrigerants." Another speaker the same evening was J. T. McLean, advertising and sales division, Westinghouse Electric & Mfg. Co., East Springfield. His talk was entitled "The Westinghouse 'Bug Bomb'."

R. C. Yantis, Wolverine Tube Co., will address the March 15 meeting in Hartford. He will speak on "The Manufacture and Fabrication of Copper Tubing."

Big Backlog for Radiators

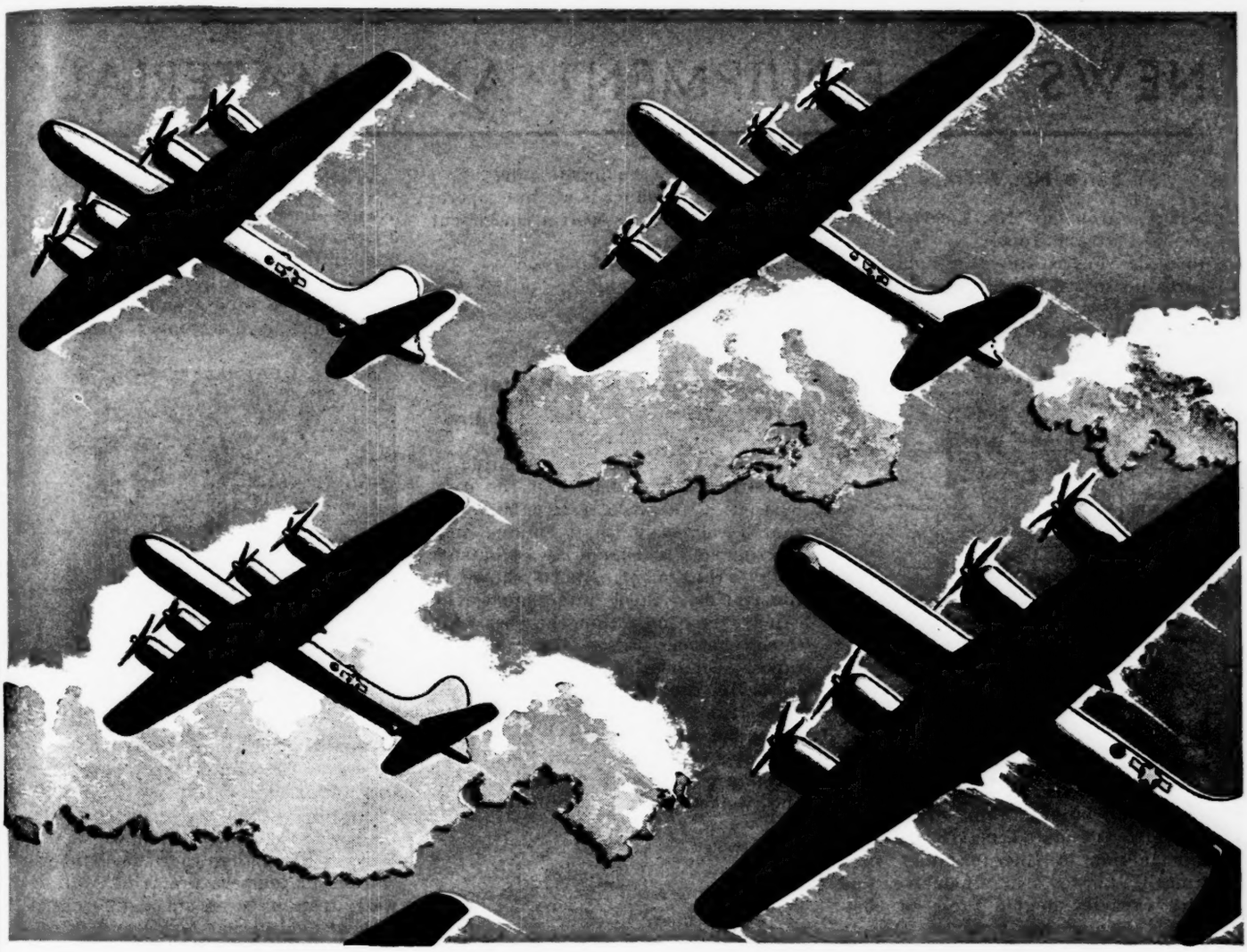
WASHINGTON—Six months would be needed to fill present unfilled orders for radiation if no new orders were placed, according to information presented to WPB's Cast Iron Boiler and Radiator Labor Advisory Committee by WPB officials. The Government spokesmen reported that production—which was 25% below schedule in 1944—is continuing to decline, in the face of expected sharp increases in civilian and military requirements for 1945. Estimates indicate that approximately 3,250,000 square feet of radiation will be needed for the veterans' hospitals program.

Minimum radiation requirements for 1945 are 25% of pre-war output, WPB said. Actual production last year was approximately 20% of normal peacetime output.

The labor advisory committee was unanimous in declaring that the chief stumbling block to increased production is "intolerable" working conditions in radiator foundries, which cause a high rate of pneumonia, tuberculosis, silicosis and industrial accidents. The members of the committee emphasized the view that workers will not remain in the foundries under adverse conditions at low pay, when they can work elsewhere on essential work for better pay under better working conditions.

The labor advisory committee made the following recommendations for improvements: (1) ventilating systems to remove gases and smoke; (2) proper heating of the foundries; (3) lockers where clothes can be kept dry; (4) showers and washrooms; (5) lunchrooms, or at least space set aside for eating; (6) sanitary toilets, and (7) safety regulations.

(Concluded on page 106)



Closely knit for greater strength

WHEN highest quality seamless steel tubing is forged into Tube-Turn welding fittings by Tube Turns' exclusive process, here is what happens: Molecules are redistributed, resulting in a closer-grained metal—a more closely knit structure that actually possesses far greater strength than before.

This increased strength is of vast importance to industry, because it means greater safety at points of greatest strain, where flow changes direction. It also means longer life for the entire piping system. Other advantages offered by Tube-Turn welding fittings over other fitting types include lighter weight, easier installation, lower maintenance cost, greater efficiency of flow, greater flexibility of layout, less space required, easier insulation.

For complete information on the superiority of Tube Turns' exclusive manufacturing methods and data on successful installations in many industries, write for Catalog 111.

• • •

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See how it gains strength

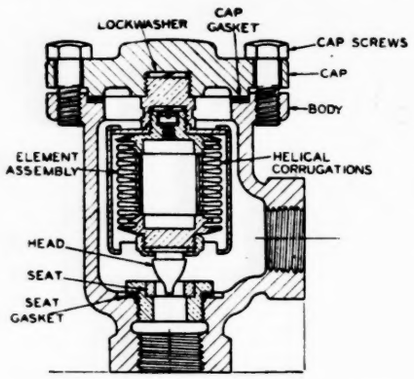
These microphotographs of the grain structure of metal used for Tube Turns before and after forging clearly show the closer-knit structure which gives finished Tube-Turn fittings added strength.

TUBE-TURN TRADE MARK *Welding Fittings and Flanges*

NEWS OF EQUIPMENT AND MATERIALS

Sarco No. 9 Traps

NAME—Sarco new No. 9 series thermostatic steam traps.
PURPOSE—For steam trapping, pressures up to 225 lb per sq in.
FEATURES—Air venting and non-freezing advantages of thermostatic traps



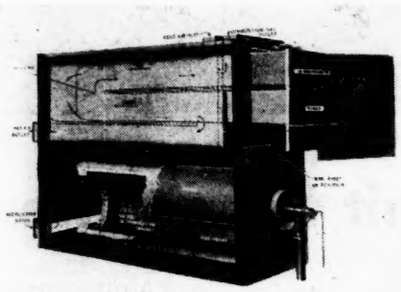
have not been available in higher pressures in larger sizes in the past. Manufacturer has now developed, however, bellows made from heavy wall bronze tubing drawn and helically corrugated, making possible introduction of line for inlet sizes from ½ in. to 2 in., inclusive, and with capacity double those of company's former No. 9 series. Heavy wall bellows is screwed into wall end closures and joints sealed to end by brazing. All sizes of new series have single bellows.
SIZES AND CAPACITIES—Six sizes ranging from ½ in. to 2 in. inlet size with capacities of 2500 lb of condensate per hour at 100 lb pressure for the ½ in. size as compared with 1300 lb for the old series and 5200 lb per hour for the new 1 in. as compared with 2000 lb per hour in 1 inch size, old series. Foregoing capacities from tests under operating conditions with condensate temperature 20F below steam pressure. Corresponding capacities for cold water passing through trap are approximately five times greater.
LITERATURE AVAILABLE — Bulletin S-1068.
MADE BY—*Sarco Company, Inc., 475 Fifth Ave., New York 17, N. Y.*

Metal Cleaner

NAME—Cyclodiene FN.
PURPOSE—A solvent metal degreaser and cleaner.
FEATURES — Contains a finger print and body acid neutralizer. Even the carefully cleaned work going through shop operations prior to final finishing, picks up finger marks, most of which are acidic. This acid, if not quickly neutralized, oxidizes metal surfaces before the finishing operation is reached. Product is a single operation degreaser. No special equipment required.
MADE BY — *Technical Processes Division of the Colonial Alloys Co., Philadelphia 29, Pa.*

Recirculating Air Heater

NAME—Ross recirculating indirect air heater.
PURPOSE—Industrial oven heating.
FEATURES—A large part of the combustion gases are recirculated so that a relatively small volume only is exhausted and made up by outside air. Arrangement of parts shown in illustration. Steel interchanger located over combustion chamber. Air to be heated passes along outside tubes, combustion gases through tubes in counterflow. Has pressed steel frame, flush steel casing with concealed bolts and flanges; heavily insulated, including insulated door; tubes are flat welded steel beaded and welded into a complete sheet.



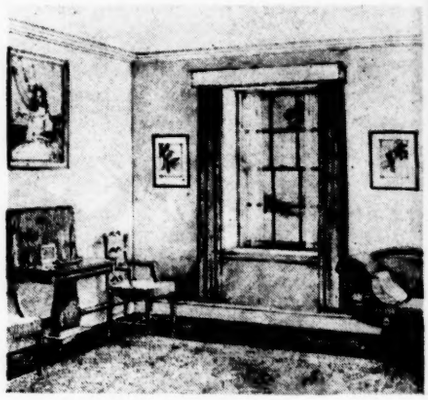
Interchanger housing is suspended from top rails of frame. Combustion chamber refractory lined. Burns oil or gas.
SIZES AND CAPACITIES—Two sizes, R-75, 750,000 Btu per hr output; R-100, 1,000,000 Btu per hr output. Has delivery temperature of 500 to 600F.
LITERATURE AVAILABLE—Four page Bulletin 137.
MADE BY—*J. O. Ross Engineering Corp., 350 Madison Ave., New York 17, N. Y.*

Pipeline Computer

NAME—Willsonn Pipeline Computer.
PURPOSE—To simplify gas pipeline problems for determining rate of flow from known length, size of pipe and rate of flow by Weymouth and General formulas.
FEATURES — Ordinary problems by Weymouth's formula are solved in 3 steps and in 5 steps by the General formula.
MADE BY—*Willsonn Computers, 925 Central Ave. Extension, Oil City, Pa.*

Webster Baseboard Convector

NAME—Baseboard heating.
PURPOSE—To provide invisible heating unit.
FEATURES — Radiator (convector) consists of a pipe around which are coiled fins of fine copper sheet and



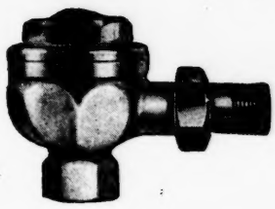
fitting behind the baseboard. Air enters at floor line, passes over heating unit and warmed air is emitted from top of baseboard. Element is installed over entire length of exposed wall so that there is little variation in temperature from wall to wall; tests have shown a differential of heat at different levels and in different sections of the heating area as less than 2F. In the basement air ducts and supply and return pipe loops are eliminated. System has been under development by company's engineers for several years and has met severe operational tests. Will be available when war conditions permit.
MADE BY—*Warren Webster & Co., Camden, N. J.*

Pop Valve

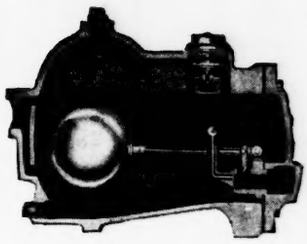
NAME—Farris pop relief valve, utility type 1800.
PURPOSE—For pressures up to 300 lb on steam, air, gas, water and other liquid process lines.
FEATURES—Said to have an especially high coefficient of lift for the disc, secured by design of disc by which velocity of fluid is trapped and its kinetic force converted into additional lift for higher relief discharge. Adjustable single blow-down ring which permits regulation of pressure to be relieved on individual operations. Uses long, accurately calibrated carbon-steel springs.

Company also has another new pop valve, utility type 1840, in sizes from ⅜ to 1 in., essentially same as foregoing.
SIZES AND CAPACITIES—½ to 2½ in.
MADE BY—*Farris Engineering Co., Palisades Park, N. J.*

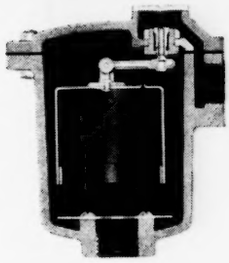
WHAT *Type* OF TRAP FOR THAT JOB?



If it's a simple radiator type you can't beat the Marsh No. 1.



If it's a float and thermostatic trap, there's a Marsh for the job. This large capacity No. 14 is typical.



If it's an inverted bucket type you need the Marsh No. 500. It is the best of the breed.

IN a recent advertisement we called attention to the fact that there is a lot more to proper trap selection than merely picking a trap to fit the pipe.

Apropos of this is the protest of a heating man in a current publication that "he can't recall a manufacturer explaining why he should use a float trap, or a bucket trap, or a thermostatic trap."

Of course every heating man knows the broad applications of these basic types of traps. So no doubt this man is seeking for the hair splitting distinctions. And, believe us, there are plenty of them —some, "trumped up"; some, real.

The trumped up ones are the result of someone favoring one particular type of trap and then thinking up arguments for its use in services where another type would do a better job. The real ones are subtle distinctions actually that sometimes arise when there is real room for doubt as to whether a float and thermostatic trap, for instance, or a bucket trap should be used.

To lay down rules covering these real distinctions is extremely difficult. There are so many factors involved that we have never attempted to cover them completely in our catalog.

But . . . when in doubt, ask us about it! You can be sure our counsel will be sound because we make *all* fundamental types of traps, and therefore have no reason to push an intermittent trap into a place where a continuous-discharge type should be used.

Yes, when you "ask the Marsh man" you assure both the right *kind* of equipment and right *make*.

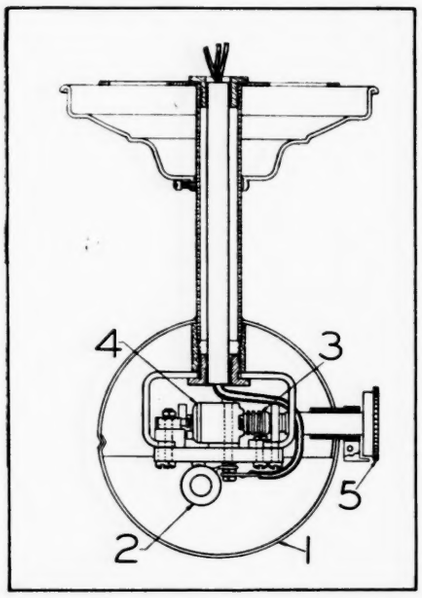
JAS. P. MARSH CORPORATION, 2089 Southport Avenue, Chicago 14, Illinois
Export Department: 155 East 44th St., New York 17, N. Y.

● The Marsh line includes radiator air valves, vents and traps for a wide range of conditions. Ask our representative or engineering department for service recommendations.

MARSH *Quality Heating Specialties* SINCE 1865

Radiant Heat Thermostat

NAME—Thermoray.
PURPOSE—Room thermostat to control the auxiliary bulb with a Sarcotherm weather control type STA when used to control a radiant heating system.



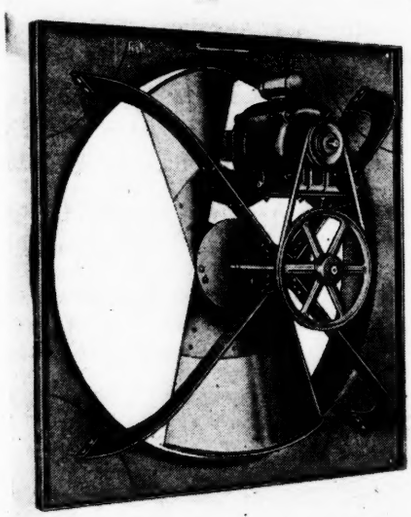
FEATURES—To assure comfort conditions, thermostat must be sensitive both to air temperature and radiant rays. Device is designed to meet these special requirements in radiant heating systems. Referring to drawing, a black hollow sphere (1) contains small electric heater (2) wired in parallel with bulb heater, and proportioned to keep outside surface of the sphere at 80F. Thermostatic bellows (3) actuates normally open switch (4) when combined effect of radiant rays and air temperature increases, so that less heat is given off by sphere, temperature inside increases, closing switch (4). This closes circuit to bulb heater, causing oil in auxiliary bulb to expand, ultimately causing hot water inlet to main valve to close. System water simply then recirculates without drawing on hot water or boiler until key room is brought back to normal temperature.
SIZES AND CAPACITIES—Thermostat (3) can be manually adjusted over a total range of 30F by turning calibrated wheel (5). Available in two types for ceiling or wall mounting.
MADE BY—*Sarcotherm Controls Inc., 222 N. Bank Drive, Chicago 54, Ill.*

Lincolnweld

NAME—Lincolnweld.
PURPOSE—A type of automatic welding said to be simpler, faster and more economical in operation than any known existing process of automatic arc welding. Has established its practicability in production welding on a variety of products including motors and generator frames, ventilating fans, tanks and pressure vessels and so on.
FEATURES — Has been successfully used for butt, lap, tee and fillet and corner welds. Process is designed for use with direct current, utilizing a bare metallic electrode which is fed through a granular flux deposited on joint to be welded. Sufficient flux is applied to completely blanket arc and molten metal; unfused flux is then reclaimed for further use. Extremely high current densities are used. For example, ⅛ in. diameter electrode may carry as much as 650 amperes. This produces greater penetration and permits smaller cross section of weld metal with resulting saving in cost and reduced warpage and distortion. Meets welding codes, rules, regulations and specifications such as ASME, Power Boiler Code, Unfired Pressure Vessel Code, and similar rules.
MADE BY—*The Lincoln Electric Co., Cleveland, Ohio.*

Herman Nelson Fans

NAME—Improved line of propeller fans.
PURPOSE—For industrial, commercial, institutional and public building applications.
FEATURES—Fan has airfoil profile with pitch increasing toward hub. This section, it is claimed, increases efficiency and promotes quiet operation as well as minimizing undesirable overload tendencies. Peripheral edge of the blade, also incorporating an air-foil profile, is flanged backwardly to reduce air turbulence. Fan blades are fabricated of aluminum and formed by the hydraulic pressure method. Fans have flexible steel arm motor mounting. Four steel arms hold the motor rigid horizontally and vertically, but are especially designed to allow slight rotation of the motor frame around the shaft to absorb and dissipate torsional vibration and prevent its transmission to the panel.

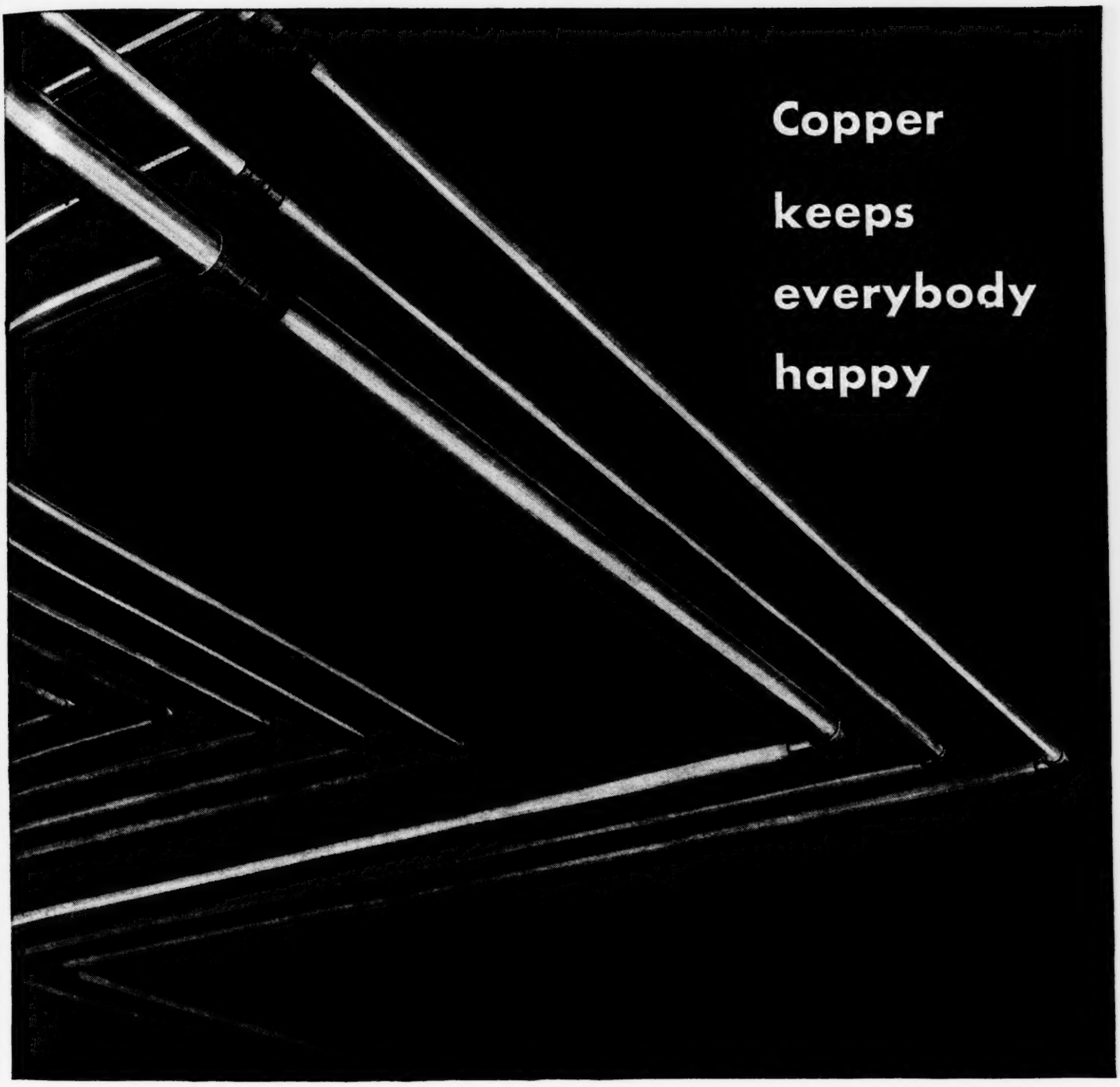


SIZES AND CAPACITIES—Available with either direct or belt drive (latter illustrated) in a wide range of sizes and air deliveries. Fans up to and including 36 in. size have two blades, while the largest three sizes have three blades.
LITERATURE AVAILABLE—Catalog.
MADE BY—*The Herman Nelson Corporation of Moline, E. Moline and Chicago, Ill.*

Ideal Dust Collector

NAME—Ideal dust collector.
PURPOSE—Unit type collector for installation on grinders, buffers, sanders, polishers and other machines.

FEATURES—Has standard attachments to simplify its installation to machines. Compact in size, it fits behind or beside machines. In operation, dust laden air is drawn through inlet pipes into twin cyclone separators where it is whirled at high speeds. Dust particles, heavier than air, drop into dust drawer. Lighter air passes on through viscous-coated filter where fine dust is removed. Clean air is discharged back into room. Filter consists of 20 layers of viscous-coated filter paper. To restore filter's efficiency after it becomes dirty, peel off first two layers. This can be done five times without affecting its cleaning ability. Under average conditions a filter lasts approximately a year or more.
SIZES AND CAPACITIES—Unit has two 3 in. diameter inlets which can serve either one or two machines. Unit is 20 x 20 x 38 in. high, weighs 265 lb, has ¾ hp, 3450 rpm motor, driving a 7½ in. diameter x 2 in. wide squirrel-cage blower wheel with a capacity of 500 cfm.
MADE BY—*Ideal Commutator Dresser Co., Sycamore, Ill.*



ENGINEERS AND CONTRACTORS know that it takes no more time or labor—and usually less—to install heating and water lines of enduring copper tube than to use short-lived materials. The overall first cost to the owner is not much different, but the ultimate cost is likely to be far lower. By its fine appearance and superior performance, a copper tube installation becomes an asset to your professional reputation.

Revere Copper Tube (99.9% pure copper) is seamless and is cold drawn with a gun barrel finish inside. It is deoxidized, and is free from flaws and blemishes. Joints are made with either soldered or compression fittings.

Designed for heating, air conditioning, water supply and other services, this tube is stamped with the Revere name and the type at regular intervals. Look for these identification marks—they insure full wall thickness and the close gauge tolerances that are so necessary for tight sweated joints.

The preference for copper and its alloys, both among engineers and contractors, and among building owners, has steadily and rapidly increased. Wartime experience with substitute materials has built up a backlog of demand which, after the war, will make copper almost essential to satisfactory installations in homes and buildings.

In making your plans you can specify such Revere materials as copper tube and pipe; Red-Brass pipe; sheet copper for tanks, ducts, pans and trays; sheet Herculoy for tanks; Dryseal copper refrigeration tube (dehydrated and sealed); copper oil burner, heat control and capillary tubes.

Revere materials are handled by distributors located in all parts of the country. The Revere Technical Advisory Service, Architectural, is always ready to serve you. Call Revere.

REVERE

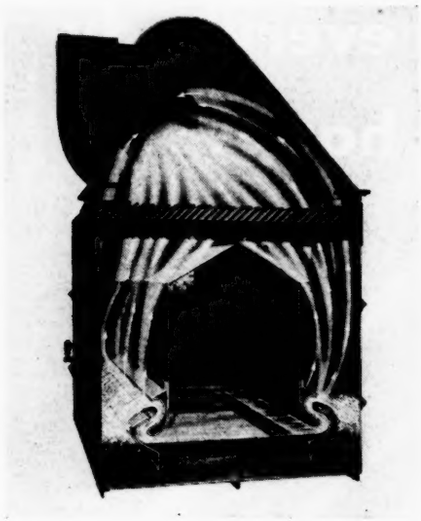
COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

Executive Offices: 230 Park Ave., New York 17, N.Y.

Air Cleaner

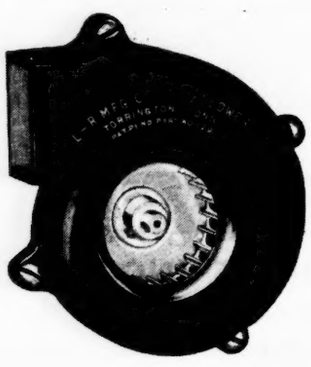
NAME—Type "N" Roto-Clone.
PURPOSE—Equipment for cleaning air and collecting dust.
FEATURES—Air is cleaned by a combination of centrifugal force and



inter-mixing of water and dust laden air. Air forced through the impeller passage induces a heavy sheet of water to move along the surface of the impeller blades. This creates a water curtain in the form of a reverse "s" through which the air must penetrate.
SIZES AND CAPACITIES—The unit is manufactured in 3 classes and thirteen sizes for the exhaust of air from 1,000 to 25,000 cfm.
LITERATURE AVAILABLE—Bulletin No. 277.
MADE BY—*American Air Filter Co., Inc., 215 Central Ave., Louisville 8, Ky.*

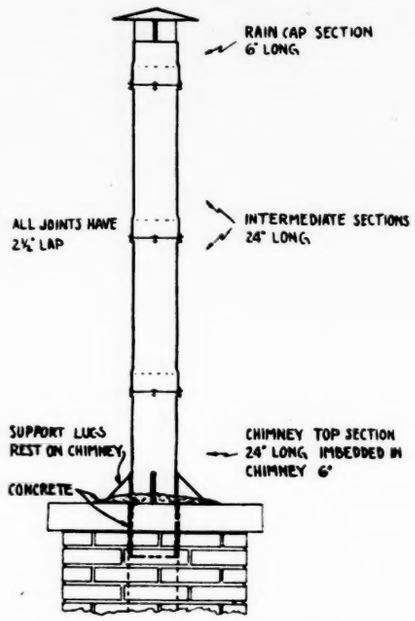
L. R. Blower

NAME—Model 2½ light-weight blower.
PURPOSE—Heat dispersion.
FEATURES—Has one piece housing with aluminum motor plate measuring 4½ in. from top to bottom. Housing of light weight high impact phenolic plastic. Wheels are turbo-type cadmium plated steel in either clockwise or counter clockwise rotation. Unit weighs 3½ oz and delivers 50 cfm at 8000 rpm. Available with shaft bores of either .1895 in. or ¼ in.
MADE BY—*L. R. Manufacturing Co., Div. of The Ripley Co., Torrington, Conn.*



Chimney Extension

NAME—Vitroliner prefabricated porcelain enameled chimney extention.
PURPOSE—To increase height of brick chimneys with insufficient draft or downdraft.
FEATURES—Made of heavy gauge steel with two coats of acid-resisting porcelain enamel fused into steel. Extension requires no guy wires and can be equipped with rain cap or revolving ventilator cap. Extension can be made in approximately one-half hour, it is claimed. Installation is made by inserting the chimney top section into top of chimney with four support lugs resting on capstone or



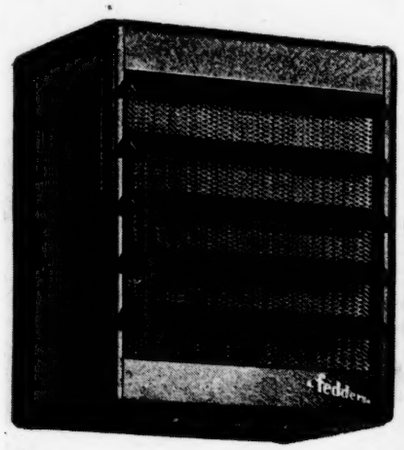
first layer of brick and grouting it into place with cement. Sections (24 in.) of Vitroliner may then be added to reach desired height.
MADE BY—*The Vitro Manufacturing Co., 60 Greenway Drive, Corliss Station, Pittsburgh, Pa.*

Arc-Welding Electrode

NAME—High tensile arc-welding electrode—type W-55.
FEATURES—Deposits are of high tensile strength. Electrodes can be used in any position, including the vertical. Recommended for welding engine mounts.
MADE BY—*General Electric Co., Electric Welding Div., Schenectady, N. Y.*

Unit Heaters

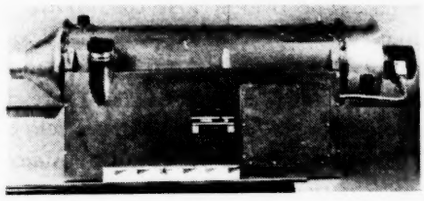
NAME—Series 15 unit heater.
PURPOSE—To provide a compact, efficient space heater.
FEATURES—The deep brazed flanges which are extruded into the headers



provide a large area of contact between tubes and headers. Relief of expansion stresses is provided between heating element and cabinet and also between adjacent tubes.
SIZES AND CAPACITIES—Line is built in 10 sizes ranging from 100 to 1,000 EDR capacity with corresponding 24,000 to 240,000 Btu capacity.
LITERATURE AVAILABLE—Catalog 15 C-1.
MADE BY—*Fedders Manufacturing Co., Inc., 57 Tonawanda St., Buffalo 7, N. Y.*

Aircraft Heater

NAME—Janitrol aircraft heater.
PURPOSE — Portable heating unit which, in addition to heating the airplane, can be removed to heat the engine or the airplane hanger.
FEATURES—Unit is self-contained except for the motive power, and



weighs less than 38 lb. It has a heat output of 40,000 Btu per hour. A 3.5 gallon fuel tank is built into the heater and contains sufficient fuel for 8 hours continuous operation. The heater has its own fuel pump driven by a small motor and a circulating air fan driven by a ½ hp, 24-volt motor.
MADE BY—*Surface Combustion, Toledo, Ohio.*

DURING these days of intense production dedicated to the single objective of winning wars, only approved orders can be filled. If your needs are of this type USAIRCO can meet them with dependable tools of air conditioning.

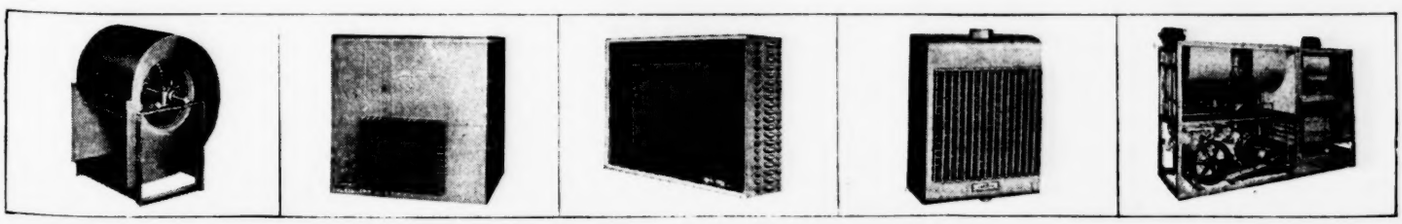
The USAIRCO line is complete. Blowers of every size and type, heavy or light duty, single or double inlet, belt drive or directly connected exhausters . . . Air washers in single, double, or triple stage in capacities for every job . . . Coils to meet every requirement . . . Unit heaters, blast heaters, unit coolers, deflecto grilles.

USAIRCO equipment is dependable because it is designed and built to meet the job requirements. Inquiries on approved needs are invited.

UNITED STATES AIR CONDITIONING CORPORATION

2101 Kennedy Street Northeast, Northwestern Terminal, Minneapolis 13, Minnesota

TWO DECADES OF AIR CONDITIONING FOR AMERICAN BUSINESS · RESIDENT REPRESENTATIVES SERVING ALL MARKETS



Degree-Days for January, 1945

HEATING AND VENTILATING'S 18TH YEAR OF PUBLICATION OF MONTHLY DEGREE-DAY DATA

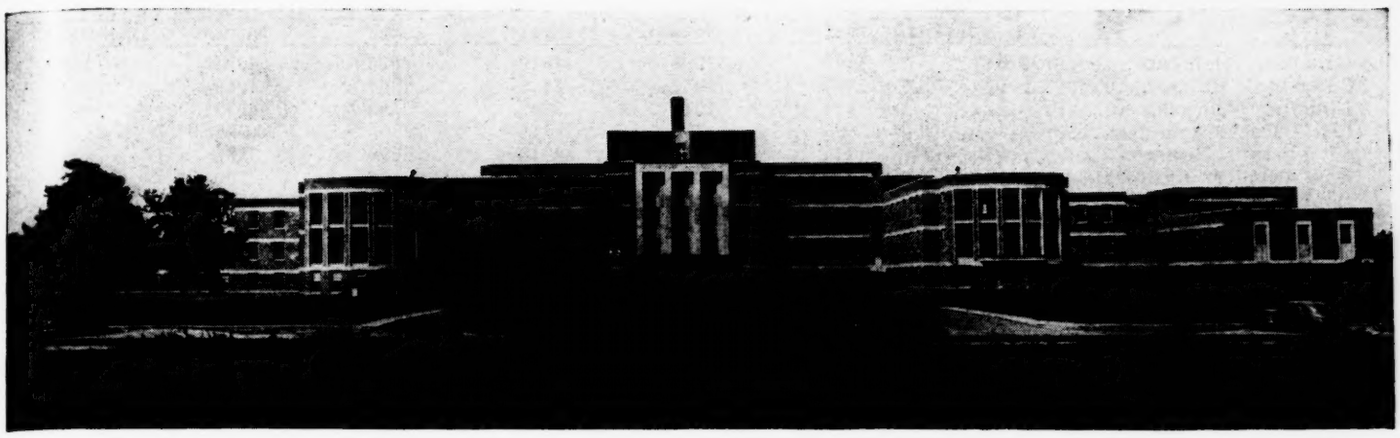
CITY	JANUARY			CUMULATIVE, SEPTEMBER 1 TO JANUARY 31			HEATING SEASON[1]
	1945	1944	NORMAL	1945	1944	NORMAL	NORMAL
Abilene, Texas	613	595	326	1668	1648	1251	2061
Albany, New York	1584	1173	1287	4208	3997	3726	6580
Albuquerque, New Mexico	875	1115	924	2644	3023	2751	4298
Alpena, Michigan	1565	1135	1431	4409	4182	4382	8299*
Anaconda, Montana	1194	1250	1321	4327	4209	4492	8357**
Asheville, North Carolina	670	792	831	2459	2631	2520	4232
Atlanta, Georgia	683	635	682	1997	1883	1813	2890
Atlantic City, New Jersey	1107	900	992	2872	2698	2727	5176
Augusta, Georgia	546	539	552	1587	1506	1441	2161
Baker, Oregon	1141	1253	1218	3780	3755	4033	7163
Baltimore, Maryland	1072	831	955	2796	2557	2619	4533
Billings, Montana	1169	1062	1318	3780	3396	4134	7119
Binghamton, New York	1504	1125	1268	4111	3967	3783	6808
Birmingham, Alabama	683	631	589	1843	1990	1502	2352
Bismarck, North Dakota	1556	1232	1807	4871	4176	5321	9192
Block Island, Rhode Island	1186	1002	1048	3126	2977	2784	5788
Boise, Idaho	1020	1244	1097	3272	3398	3382	5552
Boston, Massachusetts	1280	1051	1150	3452	3271	3280	6045
Bozeman, Montana	1220	1326	1403	4296	4304	4689	8521**
Buffalo, New York	1514	1095	1240	4023	3813	3612	6822
Burlington, Vermont	1703	1372	1429	4697	4455	4202	7514
Butte, Montana	1238	1378	1309	4567	4617	4492	8272
Cairo, Illinois	971	802	908	2573	2509	2407	3909
Canton, New York	1809	1321	1520	4943	4536	4514	8020
Charles City, Iowa	1560	1165	1560	4371	4189	4455	7588
Charleston, South Carolina	488	472	487	1358	1277	1119	1769
Charlotte, North Carolina	722	683	725	2116	1956	1945	3120
Chattanooga, Tennessee	808	765	732	2334	2332	1957	3118
Cheyenne, Wyoming	1134	1167	1215	3894	3884	4104	7466
Chicago, Illinois	1327	1041	1274	3733	3597	3193	5957
Cincinnati, Ohio	1204	894	1017	3257	2972	2813	4684
Cleveland, Ohio	1398	987	1181	3647	3340	3366	6155
Columbia, Missouri	1145	933	1110	3132	3104	3006	4922
Columbia, South Carolina	580	576	586	1699	1620	1502	2364
Columbus, Ohio	1283	962	1113	3443	3162	3133	5398
Concord, New Hampshire	1537	1315	1349	4425	4256	4081	7353
Concordia, Kansas	1025	941	1184	3032	3156	3203	5315
Dallas, Texas	605	598	617	1542	1632	1487	2256
Davenport, Iowa	1404	1015	1352	3758	3491	3685	6289
Dayton, Ohio	1347	1013	1116	3647	3400	3063	5264
Denver, Colorado	968	1011	1079	3050	3055	3355	5874
Des Moines, Iowa	1357	1038	1392	3753	3617	3762	6384
Detroit, Michigan	1465	1062	1252	3870	3649	3584	6490
Devils Lake, North Dakota	1724	1433	1949	5269	4847	5820	9970
Dodge City, Kansas	1013	1065	1116	2964	3235	3068	5035
Dubuque, Iowa	1479	1094	1442	4043	3788	3976	6790
Duluth, Minnesota	1728	1335	1727	5032	4908	5216	9443
Eastport, Maine	1399	1251	1380	4144	4167	4270	8520**
Elkins, West Virginia	1233	1011	1048	3721	3540	3265	5697
El Paso, Texas	594	748	629	1684	1899	1667	2428
Ely, Nevada	1222	1438	—	4272	4211	—	—
Erie, Pennsylvania	1413	1044	1172	3520	3476	3336	6273
Escanaba, Michigan	1617	1215	1550	4600	4385	4688	8771*
Evansville, Indiana	1096	889	949	3032	2938	2494	4244
Fort Smith, Arkansas	780	731	850	2035	2102	2027	3147
Fort Wayne, Indiana	1456	1078	1194	4034	3770	3405	5925
Fort Worth, Texas	595	572	580	1526	1581	1406	2148
Fresno, California	666	562	583	1636	1533	1494	2334
Galveston, Texas	320	374	353	742	892	683	1016
Grand Junction, Colorado	1024	1215	1233	2959	3163	3511	5548
Grand Rapids, Michigan	1390	1053	1262	3820	3659	3659	6535
Green Bay, Wisconsin	1578	1185	1538	4403	4236	4420	7825
Greensboro, North Carolina	849	812	772	2576	2490	2167	3529
Greenville, South Carolina	690	671	744	2107	1986	2078	3380
Harrisburg, Pennsylvania	1227	1001	1088	3364	3177	3069	5375
Hartford, Connecticut	1390	1106	1159	3834	3575	3316	6036
Hatteras, North Carolina	689	641	589	1734	1661	1316	2571
Havre, Montana	1445	1159	1624	4643	3865	4938	8700
Helena, Montana	1194	1292	1375	4520	4323	4433	7898
Houston, Texas	358	374	366	893	981	815	1157
Huron, South Dakota	1469	1251	1650	4388	4160	4735	8004
Indianapolis, Indiana	1255	942	1128	3384	3171	3130	5298
Jackson, Mississippi	583	—	—	1518	—	—	—
Kansas City, Missouri	1061	898	1141	2927	3008	3007	4956
Kewanee, Illinois	1370	1093	1223	3640	3759	3534	6139
Knoxville, Tennessee	830	748	815	2457	2380	2298	3670
La Crosse, Wisconsin	1552	1138	1535	4188	4250	4313	7322
Lander, Wyoming	1396	1667	1436	5033	4705	4511	7947

[1]Figures in this column are normal totals for a complete heating season, September to June, incl.

Figures in this table, with nine exceptions, based on local weather bureau reports. Exceptions are Utica, Lewiston, Kewanee, Sioux City, and Jackson, figures for which are furnished through the courtesy of Coke Sales Department, Central New York Power Corp., Utica, N. Y.; Norman E. Ross, Bursar, Bates College, Lewiston, Me.; J. M. Hartman, Engineering Department, Kewanee Boiler Corp., Kewanee, Ill., Alfred R. Wagstaff, Engineer, Sioux City Foundry and Boiler Co., Sioux City, Iowa, and H. M. Ludlow, Box 1368, Jackson, Miss., respectively; Anaconda, Bozeman, Butte and Livingston, Mont., through the courtesy of the Montana Power Company.

(a) Data not available.

[Table concluded on page 102]



St. Vincent DePaul Hospital, Norfolk, Va. Architect: James R. Edmunds, Jr., Baltimore; associate architects: T. David Fitzgibbons and Rudolf Cook and VanLenwen, Inc., Norfolk. Mechanical Engineers: Egli and Compf, Baltimore.

Boiler Plant...

FOR THE POST-WAR HOSPITAL

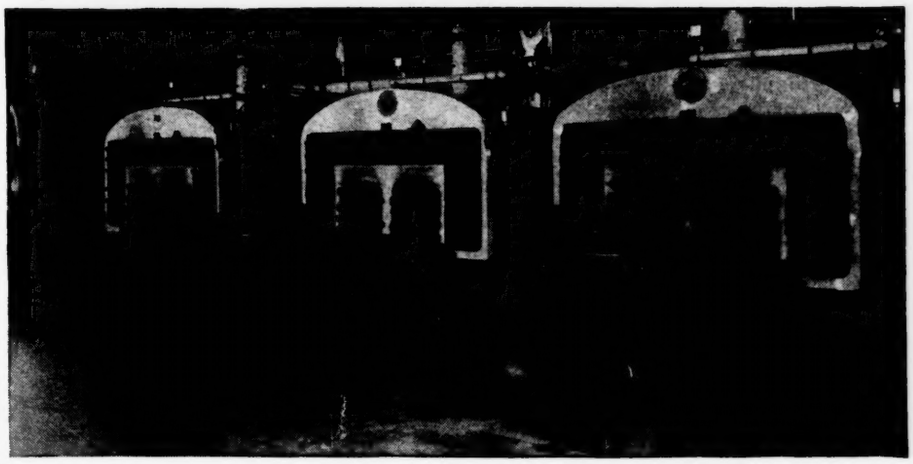
Advanced use of materials and techniques in war-time construction is well exemplified in the new St. Vincent DePaul Hospital at Norfolk, Va.

The heating system is of particular interest as it forecasts the trend of hospital heating in the post-war years. Low pressure steam is supplied by three twenty-section No. 60 SMITH cast iron boilers to a two pipe vacuum return system.

Steam for sterilization purposes is generated by a separate high pressure unit. This arrangement eliminates the necessity of a large high pressure plant for furnishing both heating and sterilization steam with resulting savings in first cost, fuel and supervision. Furthermore, the use of cast-iron boilers assures lower maintenance costs and longer life.

Specifiers and installers who will be judged by the operation of the equipment they recommend will do well to profit by the example of this type of successful installation and specify a known quantity in boiler performance . . . H. B. SMITH.

Three 20-section No. 60 H. B. SMITH cast-iron boilers with combined output of 60,000 sq. ft. steam radiation comprise the boiler plant for this new hospital. Coley and Peterson of Norfolk, Va., were the heating contractors.



H.B. *Smith*

CAST-IRON BOILERS

THE H. B. SMITH COMPANY, INC. • WESTFIELD, MASS.

Branch Offices and Sales Representatives in Principal Cities

Degree-Days for January, 1945 (Concluded)

HEATING AND VENTILATING'S 18TH YEAR OF PUBLICATION OF MONTHLY DEGREE-DAY DATA

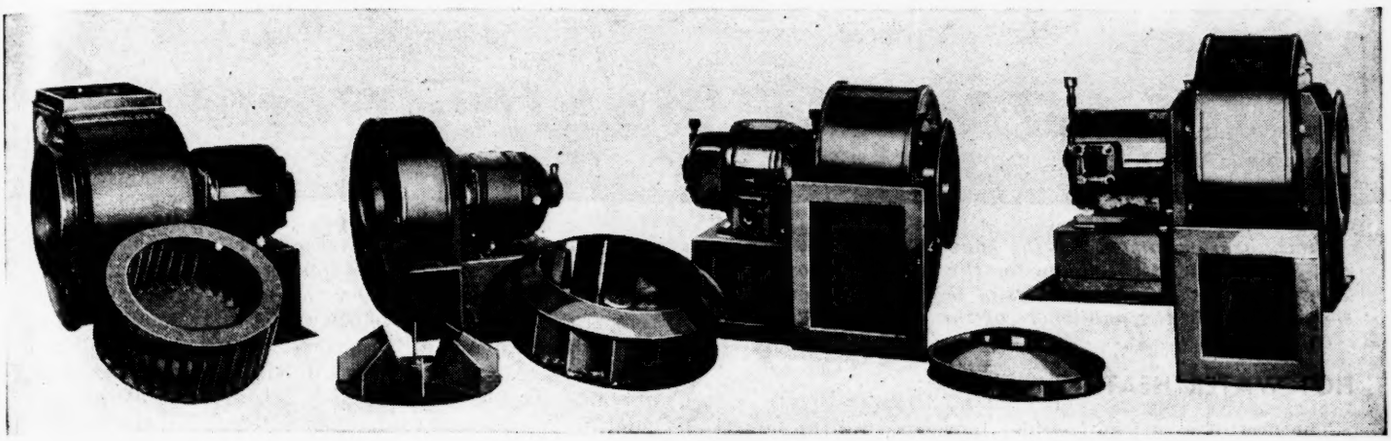
CITY	JANUARY			CUMULATIVE, SEPTEMBER 1 TO JANUARY 31			HEATING SEASON[1]
	1945	1944	NORMAL	1945	1944	NORMAL	NORMAL
Lansing, Michigan	1483	1142	1336	4240	4035	4001	7048
Lewiston, Maine	1539	1407	1452	4459	4561	4289	7707
Lincoln, Nebraska	1124	971	1311	3349	3331	3512	5999
Little Rock, Arkansas	751	695	719	2048	2054	1798	2811
Livingston, Montana	1019	1111	1220	3943	3590	3951	7205
Los Angeles, California	259	261	326	644	617	750	1504
Louisville, Kentucky	1070	824	939	2875	2665	2526	4180
Lynchburg, Virginia	963	759	856	2841	2352	2413	3980
Macon, Georgia	559	540	549	1618	1624	1446	2201
Madison, Wisconsin	1561	1167	1500	4285	4077	4258	7429
Marquette, Michigan	1565	1170	1500	4495	4325	4554	8693*
Memphis, Tennessee	797	710	744	2186	2153	1871	2950
Meridian, Mississippi	588	559	552	1618	1673	1435	2160
Milwaukee, Wisconsin	1476	1156	1383	4100	4015	3984	7245
Minneapolis, Minnesota	1621	1194	1609	4422	4263	4550	7850
Modena, Utah	1105	1306	1187	3638	3700	3859	6562
Montgomery, Alabama	529	494	515	1355	1452	1284	1884
Nantucket, Massachusetts	1133	997	1026	3046	2967	2938	5957
Nashville, Tennessee	900	772	812	2499	2385	2175	3507
New Haven, Connecticut	1294	1061	1110	3555	3381	3219	5895
New Orleans, Louisiana	334	369	332	775	977	735	1024
New York, New York	1228	957	1060	3127	2954	2909	5347
†Nome, Alaska	1670	1832	1857	4992	4905	5236	14580**
Norfolk, Virginia	843	723	738	2178	2013	1933	3350
North Head, Washington	594	633	725	2164	2171	2510	5452**
North Platte, Nebraska	1096	1109	1300	3502	3463	3786	6366
Oakland, California	551	493	527	1580	1482	1626	3143**
Oklahoma City, Oklahoma	790	780	865	2130	2240	2244	3613
Omaha, Nebraska	1243	1035	1355	3590	3551	3639	6131
Oswego, New York	1502	1152	1277	4060	3875	3771	7088
Parkersburg, West Virginia	1171	945	992	3270	3075	2822	4775
Peoria, Illinois	1398	1056	1283	3794	3625	3606	6109
Philadelphia, Pennsylvania	1188	903	1001	2976	2730	2736	4855
Phoenix, Arizona	405	408	409	979	893	990	1405
Pittsburgh, Pennsylvania	1254	930	1054	3333	3154	3003	5235
Pocatello, Idaho	1149	1499	1218	4009	3986	3867	6655
Portland, Maine	1516	1325	1321	4333	4251	3926	7218
Portland, Oregon	699	732	806	2277	2246	2530	4469
Providence, Rhode Island	1255	1036	1116	3338	3209	3246	6015
Pueblo, Colorado	1079	1083	1060	3262	3453	3224	5514
Raleigh, North Carolina	784	727	722	2267	2132	1975	3234
Rapid City, South Dakota	1196	1141	1320	3910	3696	4021	7118
Reading, Pennsylvania	1260	958	1088	3288	3038	3102	5389
Red Bluff, California	(a)	—	—	(a)	—	—	—
Reno, Nevada	989	1007	1042	3299	3348	3326	5892
Richmond, Virginia	930	787	831	2507	2352	2211	3695
Rochester, New York	1542	1127	1252	4187	3894	3666	6732
Roseburg, Oregon	649	722	744	2228	2297	2485	4428
Roswell, New Mexico	689	811	786	2156	2387	2296	3484
Sacramento, California	630	562	614	1599	1495	1610	2653
St. Joseph, Missouri	1135	937	1187	3151	3184	3147	5161
St. Louis, Missouri	1124	849	1060	2972	2767	2798	4585
Salt Lake City, Utah	939	1421	1110	2971	3575	3259	5555
San Antonio, Texas	424	456	381	1159	1216	854	1202
San Diego, California	301	266	332	697	626	819	1645
Sandusky, Ohio	1402	997	1181	3667	3370	3323	6208
San Francisco, California	458	413	465	1344	1173	1414	3264**
Sault Ste. Marie, Michigan	1793	1281	1581	5065	4724	4828	9285**
Savannah, Georgia	412	405	409	1155	1091	1007	1490
Scranton, Pennsylvania	1430	1065	1172	3895	3620	3446	6129
Seattle, Washington	637	649	781	2190	2238	2650	4934**
Sheridan, Wyoming	1244	1278	1431	4007	3911	4629	8008
Shreveport, Louisiana	597	580	555	1547	1599	1324	1938
Sioux City, Iowa	1315	1131	1435	3959	3892	4018	6898
Spokane, Washington	1002	1079	1172	3463	3572	3755	6355
Springfield, Illinois	1259	972	1181	3761	3196	3183	5373
Springfield, Missouri	1021	889	973	2889	2921	2647	4428
Syracuse, New York	1568	1203	1277	4200	3997	3768	6893
Tacoma, Washington	684	726	812	2455	2527	2763	5181**
Terre Haute, Indiana	1195	924	1070	3282	3094	2910	4872
Toledo, Ohio	1496	1068	1203	4053	3723	3392	6077
Topeka, Kansas	1039	893	1135	2899	2978	3018	4969
Trenton, New Jersey	1240	970	1014	3237	3043	2774	4933
Utica, New York	1606	1267	1248	4492	4253	3785	6796
Valentine, Nebraska	1246	1200	1370	4059	3841	4095	7039
Walla Walla, Washington	835	967	989	2795	3044	2898	4808
Washington, D. C.	1062	855	970	2839	2633	2711	4626
Wichita, Kansas	956	878	1094	2691	2789	2877	4673
Williston, North Dakota	1549	1258	1805	4887	4298	5463	9323
Winnemucca, Nevada	1123	1313	1150	3642	3575	3739	6427**
Yakima, Washington	951	1102	1159	3113	3296	3587	5599

†Nome data are for December.
(a) Data not available.

*Includes August.
**Includes July and August.

[1]Figures in this column are normal totals for a complete heating season, September to June, incl.

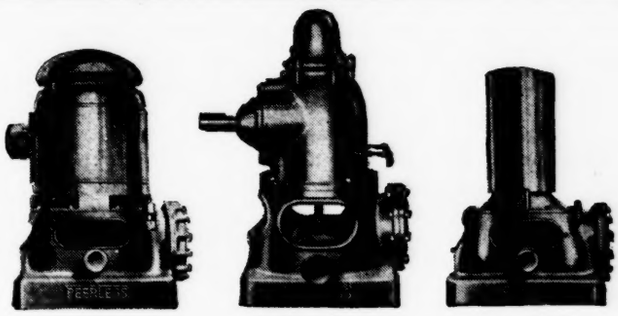
Johnson FANS AND BLOWERS *improved by continuous research*



Johnson Health-aire Propeller Fans and Blowers of various types are now available for industrial and commercial users. And back of every one of these products is the cumulative "know-how" growing out of more than twenty-five years of constant research, experiment, improvement, perfection. New units were created and added to the expanding line to keep pace with every modern requirement. Johnson engineers have solved literally thousands of ventilating and air-handling problems – their counsel is available to you at all times to help produce "climate as you like it."

- **BLOWERS (above) available from 6" to 50".**
- **PROPELLER FANS (left) available from 12" to 72".**

★ **Johnson Fan and Blower Corporation**
1321 W. Lake Street Chicago 7, Illinois ★



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Water for Air Conditioning

Thousands of Peerless Pumps have been in operation for more than 10 years without need for repair. Precise factory methods insure continued operation. Because of the exclusive engineering design, construction and fine workmanship of the bowl and impeller assembly, original efficiencies are closely maintained over a greatly extended performance period.

FEATURES – (*Turbine Type*)
Water-cooled head bearings • Choice of oil or water lubrication • Double Bearings in each bowl • Fully-enclosed impellers • Double Seal impellers.

ARMY NAVY E — PEERLESS PUMPS

PEERLESS PUMPS

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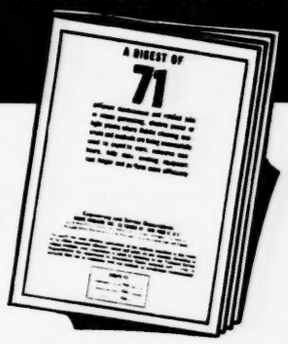
71 Ways to Expedite Power Plant Maintenance



DESCRIBED IN NEW, FREE OAKITE DIGEST

Power plant engineers will welcome this new revised and enlarged digest on power plant maintenance because in its pages are described many performance-proved Oakite materials and methods for expediting maintenance work . . . reducing equipment out-of-service time to an absolute minimum.

The Oakite digest describes effective, fast, low-cost techniques for cleaning heat exchangers, descaling Diesel cooling systems, cleaning steam condensate meters, stripping paint from transformers before repainting and 67 other commonly recurring power plant maintenance jobs. The digest is FREE. Send for your copy TODAY!

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REVIEWS

Articles are abstracted for the convenience of the readers. Orders cannot be taken for the full length articles. Those desiring to obtain copies of the article referred to should write to the publishers of the respective articles.

HOT WATER HEATING

The first of a series of guides incorporating the latest technical data on installation methods on radiator heating has appeared under the title "I-B-R Installation Guide Number 1—One Pipe Forced Circulation Hot Water Heating Systems." The data are limited to buildings having a heat loss of not over 60,000 Btu per hr. Published by The Institute of Boiler and Radiator Manufacturers, the booklet presents a simple, efficient and economical basis for installing a one-pipe forced hot water system. The booklet has been developed as a direct outgrowth of the research program sponsored by the Institute in the I-B-R Research Home at the University of Illinois.

The calculation and design of one-pipe forced circulation hot water heating systems is covered in five simple steps in the guide. The method recommended is based on the common practice of a temperature drop through the system of 20F and a diversion of 20% of water through each radiator. The five steps are as follows: Determine the heat loss; select the main size; determine the radiation; select the boiler; determine the pump size.

The Institute explains that the hot water system covered in these five simple steps can be installed at a cost low enough to meet the budget requirements of the small and medium size home.

A recommended calculation sheet for jobs is reproduced in the guide. Tabulations are given showing heat loss factors, Btu requirements for quantities shown, equivalent Btu heat loss, heat emission rates. One section explains in detail the method of calculating fraction heads and radiator sizes based on the temperature drop in the system. Following the step by step discussion of methods, the authors of the guide provide users with tabulations of equivalent lengths in feet of pipe, friction factors, temperature drop in main, and temperature drop in radiators. This section is accompanied by a calculation sheet showing the application of the method to a typical dwelling.

The book was prepared by an editing committee headed by H. F. Randolph, vice-president, International Heater Company, Utica, New York. "One Pipe Forced Circulation Hot Water Heating Systems," published by The Institute of Boiler and Radiator Manufacturers, 60 E. 42nd St., New York 17, N. Y. Price, 25c.

RADIANT HEATING

The third in the series of engineering bulletins on radiant heating and cooling of angle factors issued by Cornell University's Engineering Experiment Station. The present booklet is devoted to a discussion of the thermal environment and radiant heating, and discusses heat transfer by convection and by radiant heating, heat loss by evaporation or moisture, followed by a very practical discussion of operative temperatures as originally introduced by the John B. Pierce Laboratory for Hygiene.

The author, Professor C. O. Mackey, has developed and included a nomographic chart for determining the operative temperature when the mean radiant and air temperatures and air velocity are known. Following the presentation of this chart the method of heat balances, treated by Professors Raber and Hutchinson in previous papers, is discussed, together with the calculation of an actual example of determining the various temperatures involved and which require the solution of a large number of simultaneous equations. A comparison of the advantage of floor vs. ceiling vs. wall radiant heating is presented, and the effects of cold windows discussed.

Paper bound, size 8½x11 in., 16 pages, titled "Radiant Heating and Cooling, Part III," by C. O. Mackey, Bulletin No. 33, Cornell University Experiment Station, Ithaca, N. Y. Price, forty cents.

COMFORT IN AIRCRAFT

Under the title of "Comfortization of Aircraft," Albert A. Arnhym of the Solar Aircraft Company has prepared a book dealing not only with heating and ventilating, but other functions which contribute to the comfort of the crew and passengers in aircraft, including soundproofing, seating and resting, lighting, food supply, and entertainment. However, of the 23 chapters, 21 relate to heating and ventilating.

As E. T. Price, president of Solar Aircraft states in his foreword to the book, "Every step forward in the speed of transportation has been followed by corresponding improvements in comfort. We are a comfort-loving race. One of the essentials in our daily living, it appears, is to achieve a degree of comfort to the physical senses . . . Little has been achieved [in airplanes] toward comfort. And yet, if the aeronautical engineer or builder neglects this phase his product will not meet with public acceptance. Throughout all history, men have succeeded who invented or sold "comfort". It is my feeling this is and will be particularly true in the airplane industry."

The author discusses the requirements of air supply with particular attention to the relationship between that supply and altitude, describes the method of air supply presently used in planes, and shows methods of air distribution. He presents the basic formulas for calculating the ventilation in a plane and shows how to select the air supply. As in ventilation, heat supply in planes varies considerably from land practice and the author has done a particularly fine piece of work in presenting this together with the calculations of heat requirements in easily understood form and including the heat requirements for ground heating. Methods of heat supply, theory of exhaust gas, heat exchangers, and selection of heat supply are thoroughly covered.

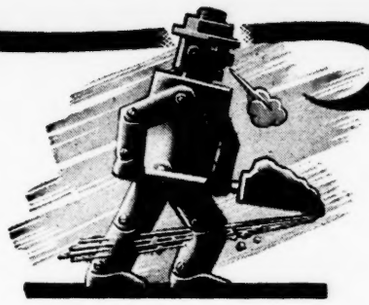
Cloth bound, 6 1/4 x 9 1/4 in. in size, 347 pages, published by Pitman Publishing Corp. Price, $7.50.

VAPOR TRANSMISSION

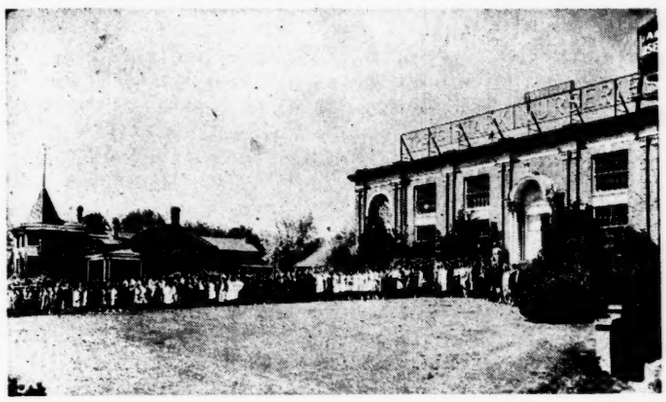
Bulletin 22 of the University of Minnesota Engineering Experiment Station is designed to give builders and contractors some practical guide in the construction of insulated buildings where the condensation of

(Concluded on page 106)

Best Way to Save Coal is to Stop Wasting It



Old-fashioned hand-firing wastes 10% to 20% of the coal you buy, and wastes manpower as well. You can eliminate these losses with IRON FIREMAN STOKERS



The Famous Stark Nurseries Save Fuel with Iron Fireman

The Stark Brothers Nurseries & Orchards Co., of Louisiana, Mo., was selected by Luther Burbank as the organization best fitted to carry on his uncompleted work. This famous nursery, now in its 128th year, is the oldest and largest in America and is still owned and operated by the Stark family.

Ten years ago the firing job in the two office buildings was turned over to Iron Fireman. One of the unexpected results, according to Mr. Lawrence Stark, was the increased efficiency of the office staff due to a lowered absentee rate. This was ascribed by Mr. Stark to the more even temperature maintained in the offices. Fuel savings have accrued through the years, costs dropping approximately 40% upon conversion from hand firing to Iron Fireman. In addition to the office buildings, four Stark homes are heated by Iron Fireman stokers.

HAVE you a fuel problem? Have you a labor problem in firing the boilers under your care? Do you need *more steam* from your present boilers, while burning *less coal*—with *decreased firing labor?*

Iron Fireman automatic stoker firing is providing a satisfactory answer to these problems in scores of thousands of buildings and plants. It is doing this by feeding coal automatically—always at the exact rate required by fluctuating loads, while the forced air supply, metered by the Iron Fireman Volumeter, is constantly balanced to the amount of coal being burned. The result is highly efficient combustion with substantially decreased fuel and labor costs. Ask any Iron Fireman owner!

What About YOUR Heating Plant?

Iron Fireman engineers are ready to make a survey of your boiler plant, without cost or obligation on your part. This will give you reliable data on the fuel and labor savings possible with Iron Fireman firing. Our nationwide dealer organization is at your service. Address Iron Fireman Manufacturing Company, 3802 West 106th Street, Cleveland 11, Ohio. Plants: Portland, Oregon; Cleveland, Ohio; Toronto, Canada.

OUTSTANDING PERFORMANCE OF IRON FIREMAN STOKERS is the result of the application of sound principles of combustion and engineering. Coal is fired under forced draft, with automatic regulation of air and coal.

IRON FIREMAN

Automatic Coal Stokers

(Concluded from page 104)

moisture in walls is apt to be a problem.

This bulletin covers the results of the first part of a cooperative research program between the Insulation Board Institute and the University of Minnesota Engineering Experiment Station, the purpose of which was to study the vapor permeability properties of structural insulating board and of the walls and structures in which these boards are often used. Bulletin 22 contains the final results of a series of tests on insulation board material, both individually and incorporated into test walls. A later bulletin will discuss the results of investigations made during the second part of the program—an analysis of complete structures, containing the various walls, under adverse moisture conditions.

A discussion of the theory of vapor transfer through materials is presented in this publication. A comparison of this theory with the theory of heat flow through materials, a discussion of the effects of temperature and of the physical properties of materials on permeability, suggestions as to terminology and a discussion of the special rating apparatus by means of which the theory was checked on individual materials and numerous combinations of them in complete wall sections, are also presented.

Various types of paint and surface finish used to reduce vapor permeability were studied to determine the practicability of applying them. A list of these finishes and their relative vapor resisting properties is given in the bulletin.

Building location has been studied and a line has been suggested, dividing the United States into two parts, one in which vapor barriers are desirable and recommended and the other in which barriers may be omitted with reasonable safety.

Vapor Transmission Analysis of Structural Insulating Board, by Frank B. Rowley and C. E. Lund. 6 x 9 in., 71 pages, paper bound. Price, 40c. Obtainable from the University of Minnesota, Engineering Experiment Station, Minneapolis, Minn.

BRIEF REVIEWS

PROGRESS IN ENGINEERING—The December, 1944 issue of the Journal of the Western Society of Engineers is dedicated to mark the 75th anniversary of the society. It contains 15 special articles, each written to present a history of that period in special engineering fields such as steel, bridge development, communication progress, advances in hydraulic and sanitary engineering, engineering in the gas industry, engineering education, etc. Western Society of Engineers, 205 West Wacker Dr., Chicago 6, Ill.

POWER IN INDUSTRIAL PLANTS—A standard size, 110 page publication entitled "Electric Power Distribution for Industrial Plants" and representing an immense amount of work in coordinating available data on industrial electric distribution systems. Divided into six main subdivisions titled System Planning; Primary Substations and Feeders; Transformers, Primary Switchgear and Low-Voltage Feeder Protection; Fault Current Calculations; Wires and Cables. Published by the American Institute of Electrical Engineers, 33 W. 39th St., New York 18, N. Y. Price $1, paper bound, size 7¼ by 10⅝.

STORM WINDOWS—A 4-page circular for house owners describing these windows and why they are used, weather stripping, how storm windows are fitted, hardware, painting, storing and buying. Punched for filing in a ring binder. This is the first of a series of circulars to be issued by July 1 and which will discuss financing the home, design of the home, solar orientation, heating the home, insulation, and similar subjects. Single copy sent free to individuals writing to Small Homes Council, University of Illinois, Urbana, Ill.

BARN HEAT LOSS—An article by W. C. Krueger, agricultural engineer of Rutgers University, calling for better door and window design to reduce heat loss in dairy barns, entitled "Door and Window Design to Eliminate Heat Loss in Dairy Barns," *Agricultural Engineering*, January, 1945.

News of the Month

(Concluded from page 92)

Ferry C. Houghten

WASHINGTON—Commander Ferry C. Houghten, U. S. Naval Reserve, assigned to the Bureau of Medicine and Surgery, died suddenly January 25 while attending the ASHVE convention in Boston. He was stricken the evening before and was rushed to the Chelsea Naval Hospital, where he died, at the age of 56.

Commander Houghten was a graduate of Olivet College and the University of Washington, and taught physics and science on the west coast until 1918, when he joined the U. S. Bureau of Mines in Pittsburgh. In 1920 he was appointed on the staff of the ASHVE Research Laboratory and worked on heat transmission investigations for the next four years. He served as secretary of the Society during 1924 and 1925 and in the latter year was appointed as director of the Research Laboratory at Pittsburgh. He held this position until 1942 when he left the Laboratory to enter the Navy.

During the period in which he was director of the Laboratory he was the author or co-author of a large number of papers on varied subjects investigated by the Laboratory, and in addition contributed numerous papers to engineering journals and served on many committees of the Society. He was president of the ASHVE Pittsburgh chapter in 1931.

For his work as an outstanding research investigator the Society presented to him its highest honor, the F. Paul Anderson Medal, in 1944, at its 50th annual meeting. Previously Olivet College conferred an honorary degree of Doctor of Science on him at its Founders Day in 1941.

Commander Houghten leaves a wife, three sons, all in military service, and a daughter.

Many representatives of the ASHVE council, advisory council and committee on research, and of the Washington chapter were in attendance at the funeral services, January 30. He was buried in Arlington National Cemetery.

Eshelby F. Lunken

CINCINNATI — Eshelby F. Lunken, president of The Lunkenheimer Co., Cincinnati, valve manufacturers, died suddenly January 25 of a heart attack. He was fifty-four. At the time he was stricken, Mr. Lunken was making preparations to attend the annual dinner of the National Association of Manufacturers as a guest of honor, The Lunkenheimer Co. having been one of the Cincinnati firms that founded the Association.

He was a leader in business and civic affairs and was actively interested in aeronautical development, having been a moving spirit in the establishment of Lunken Airport. He also worked closely with the Committee for Economic Development, of which he was a member.

Mr. Lunken was a son of Edmund H. Lunken, who at the time of his death in July, 1944, was chairman of the board. He was connected with Lunkenheimer for 35 years, and served as president 26 years. He was a grandson of Frederick Lunkenheimer, founder of the company.

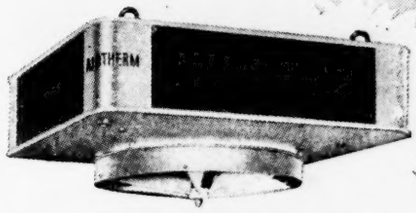
Individually Controlled AIRTHERM Unit Heaters

Will Cut Your Fuel Bill

Airtherm Unit Heaters are individually controlled. They give heat only where you want it, when you want it. Heat is delivered uniformly and efficiently, eliminating "dead spots" in your plant.

Airtherm Unit Heaters are now available equipped with copper coils.

Let us show you how we can reduce your heating costs through efficient, controlled heating. Write for bulletin giving complete range of available sizes.



For Vertical Delivery

For Horizontal Delivery

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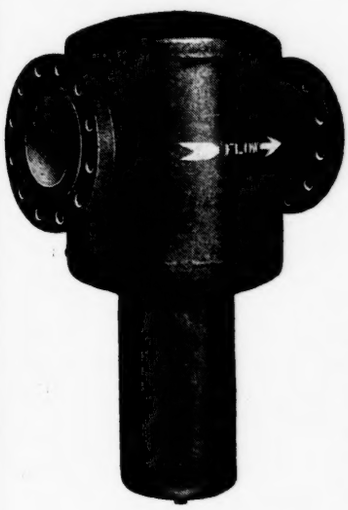
MANUFACTURING COMPANY
722 South Spring Avenue St. Louis 10, Missouri



KEEP YOUR STEAM LINES *Clean* WITH **ADSCO** **SEPARATORS AND STRAINERS**

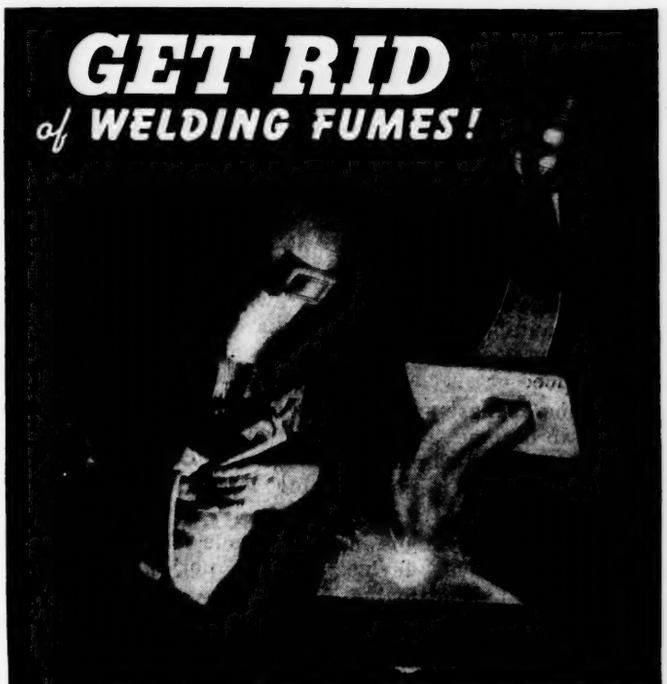
Remove dirt, oil and water particles from the steam with ADSCO Separators — made of semi-steel or fabricated steel, for low or high pressure lines, horizontal, vertical or special types.

Protect your meters, traps and other fixtures from sand, scale and other foreign matter with ADSCO Strainers. When in the market for T or Y Type Strainers and Macomb or special type strainers for low or high pressure service, send details of your strainer problem to ADSCO for recommendations and prices.

AMERICAN DISTRICT STEAM COMPANY
NORTH TONAWANDA, NEW YORK

MAKERS OF "UP-TO-DATE" STEAM LINE EQUIPMENT FOR OVER 65 YEARS

GET RID of WELDING FUMES!



The powerful suction created by Ruemelin Fume Collectors draws out noxious gases and smoke at the source. Cleans shop air with minimum loss of building heat. Covers maximum territory. Guards employee health. More than 1,000 serving war plants all over the nation. Shipped completely assembled, easy to install.

Write for Bulletin 37-C

RUEMELIN MANUFACTURING CO.
8808 N. PALMER STREET MILWAUKEE 12, WIS.
Manufacturers and Engineers, Sand Blast and Dust Collecting Equipment, Welding Fume Collectors

WHAT READERS SAY

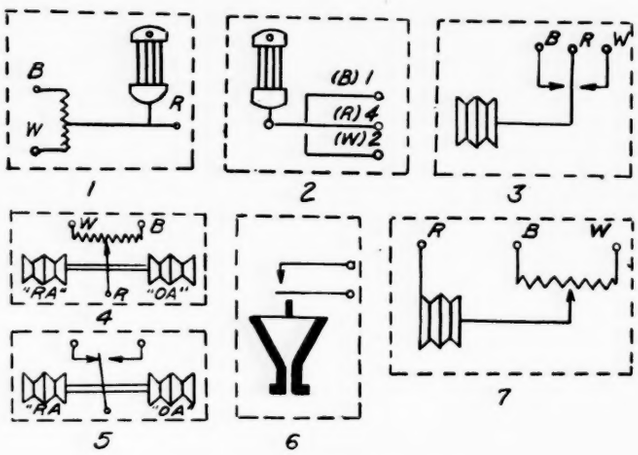
Standard Drafting Symbols

EDITOR, HEATING AND VENTILATING:

Your editorial on "Standard Drafting Symbols," which appeared in the January issue, is quite timely.

As an engineer for a Southern utility company, my work is primarily electrical, but it so happens that your proposal for a set of standardized drafting symbols for refrigerating and air conditioning work directs attention to a problem on which I have had to devote considerable time and study for the past several years.

To prevent electrical leakage in moist climates, it is often necessary to dehumidify the air in buildings which house electric communication apparatus. This dehumidification is often accomplished by using conventional air conditioning machinery equipped with



Suggested Drafting Symbols

1 Modulating type humidistat. 2 Two-position type humidistat. 3 Two-position thermostat. 4 Modulating type differential thermostat. 5 Two-position type differential thermostat. 6 Pressure contactor. 7 Modulating thermostat.

automatic electrically operated control circuits. As a rule, these automatic control circuits are considerably more complicated than the familiar circuits which are used in comfort air conditioning work. However, it has been found that by developing suitable drafting symbols for the schematic circuit drawings, the operation of these automatic control circuits can be readily understood by electrical maintenance men who are not experienced or specialized in air conditioning work.

Some of these symbols may require too much drafting time to become widely popular with the air conditioning industry, but I can assure you that all of them represent the result of a considerable amount of study and experience.

The list of symbols in your article did not include a humidistat. This device, although not widely used in comfort air conditioning, finds a large number of applications in control circuits involving the control of atmospheric humidity.

To me, it seems apparent that any symbol which the industry may standardize for thermostats, humidistats, or pressure contactors should be so devised that a reader can easily determine the direction in which the instrument will operate in response to an increase of temperature, humidity, or pressure. The thermostat symbol which the industry is now using, shown in your article, does not possess this advantage. If it should become necessary to add another contact on it, and if it should then be employed in a complicated circuit, even an experienced engineer could find himself wondering, "which way is hot, and which way is cold."

In closing, perhaps it may be appropriate to suggest that the air-conditioning industry might be willing to consider the adoption of several symbols which the electrical industry has already standardized. For example, standard symbols for such items as switches, potentiometers, fuses, relays, and motors of various types are already available. In New York, information regarding these symbols may be obtained from the American Standards Association at 29 West 39th St.

In my opinion, you have undertaken a most worthy project in directing attention to this problem, and as a member of the AIEE, I wish to extend congratulations.

Atlanta, Ga. *John D. Askew*

. . . Since the Last Issue

Frigidaire Division, General Motor Corp., Dayton, Ohio, has appointed **James F. Pedder** as advertising manager and **Ellsworth Gilbert** sales promotion manager, effective immediately. All advertising, display, publicity, promotional and training activities for all Frigidaire appliance, commercial refrigeration and air conditioning products, formerly the responsibility of four different departments, now will be centered in two newly created departments—the advertising department and the sales promotion department, under the direction of Mr. Pedder and Mr. Gilbert, respectively. Mr. Pedder held the pre-war position of assistant advertising manager, and more recently advertising and promotion manager of the appliance division. He has been with the Frigidaire Division in various advertising capacities for more than 17 years. Mr. Gilbert was formerly sales training manager of the appliance division. He has been associated with Frigidaire for over 15 years.

T. W. Markham, formerly advertising and promotion manager of Frigidaire's Commercial Division, had left the employ of the Frigidaire Division to establish a Frigidaire dealership in Southern California in the Los Angeles district.

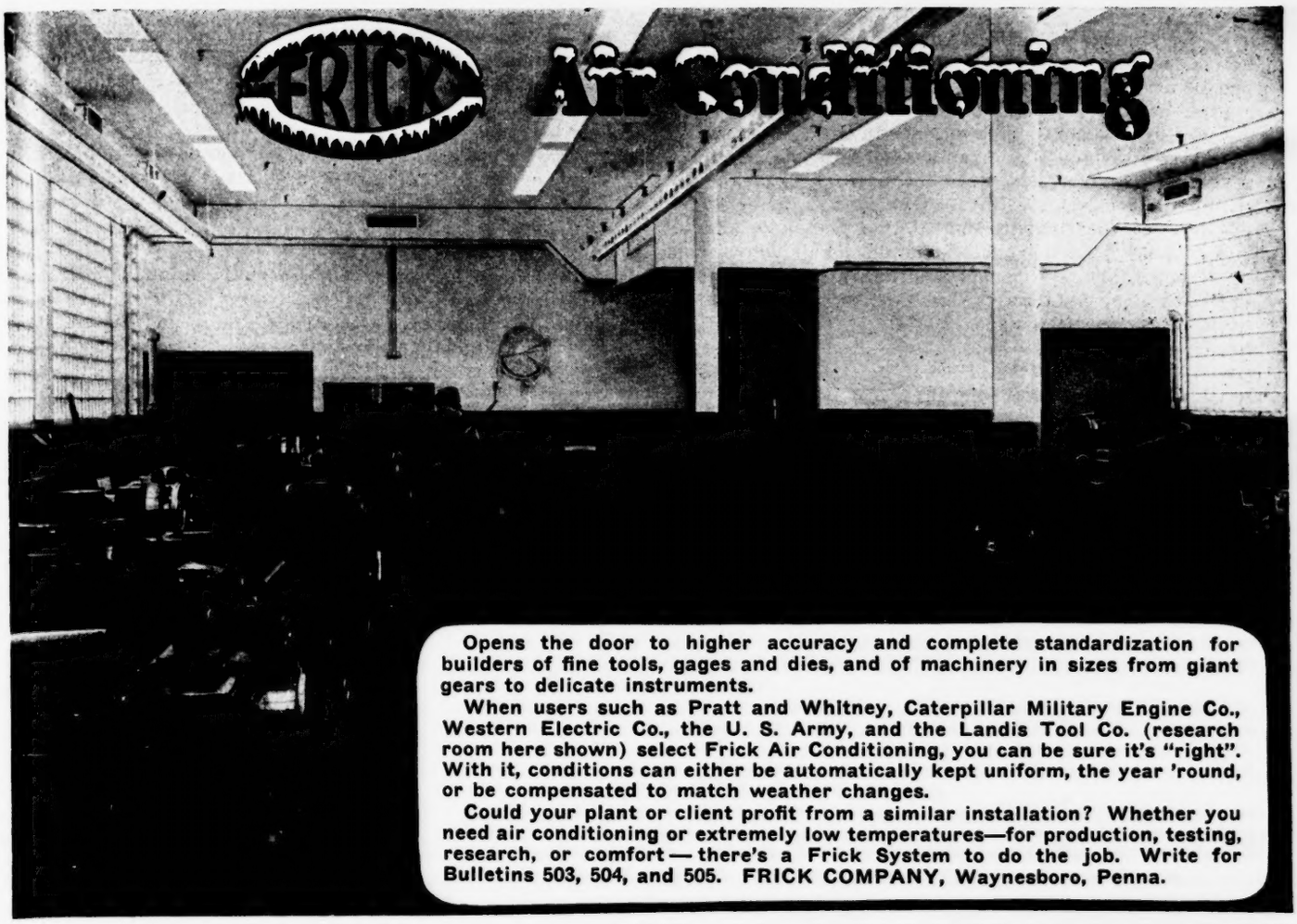
Harold N. Blount, formerly of Curtiss-Wright Corporation, has joined the staff of **Buffalo Bolt Company**, North Tonawanda, N. Y., and will have charge of market and product research.

Anthracite Industries, Inc., New York, announces that **Edward H. Walker**, formerly Advertising Manager and Director of Public Relations, has been elected Vice-President in Charge of Public Relations.

General Controls Company, Glendale, Calif., has appointed **Joseph W. Wilson** as manager of the Glendale branch office. Mr. Wilson served as heating engineer for Holland Furnace Company for 15 years and as manager of several Holland branches. He was also sales engineer and later production manager of Kinney Aluminum Company. In his new position he will devote his time to serving users of automatic controls in Southern California, Arizona, and Southern New Mexico.

J. W. Wilson

The Bennett Fittings Co., Huntington Park, Los Angeles, Calif., has been acquired by the **J. A. Zurn Mfg. Co.**, Erie, Pa., manufacturers of Zurn plumbing-building-drainage products.



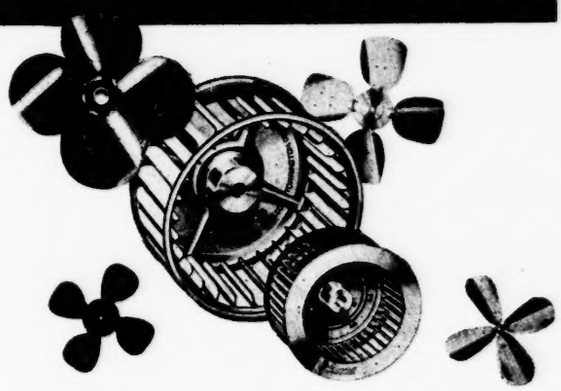
Opens the door to higher accuracy and complete standardization for builders of fine tools, gages and dies, and of machinery in sizes from giant gears to delicate instruments.

When users such as Pratt and Whitney, Caterpillar Military Engine Co., Western Electric Co., the U. S. Army, and the Landis Tool Co. (research room here shown) select Frick Air Conditioning, you can be sure it's "right". With it, conditions can either be automatically kept uniform, the year 'round, or be compensated to match weather changes.

Could your plant or client profit from a similar installation? Whether you need air conditioning or extremely low temperatures—for production, testing, research, or comfort — there's a Frick System to do the job. Write for Bulletins 503, 504, and 505. FRICK COMPANY, Waynesboro, Penna.

MATCHLESS

PERFORMANCE



To secure matchless performance in any unit requiring the movement of air, it is essential to have the *correct* air impeller. Costly design changes and production delays may be avoided if you will let us help you make the choice *in the early stages of design.* Among the great variety of propeller fan blades and centrifugal blower wheels which we make, there will be one exactly right for your application.

The many factors to be considered in selecting an air impeller are listed on our Air Impeller Specification sheet. Write for one today, then submit it for our recommendation and quotation.

AIR IMPELLERS *for every purpose*

THE TORRINGTON MANUFACTURING COMPANY. TORRINGTON. CONN.

Engineers EFFICIENCY ANALYSIS SERIES 3000 TEST SET

HAYS COMBUSTION SET

Portable
SIZE OF CASE 7⅞"x5"x15" HIGH
WEIGHT 9 LBS.

For accurate, quick combustion analysis. Combines single unit gas analyzer with a diaphragm type draft gage and flue gas thermometer. Completely enclosed in steel case with leather handle, weight 9 lbs. Of particular benefit to service and heating engineers and installers of oil and gas burners, stokers, furnaces, and boilers. Full details in Bulletin 43-362.

The HAYS CORPORATION
COMBUSTION INSTRUMENTS AND CONTROL
MICHIGAN CITY, INDIANA, U.S.A

P. W. McCoy, who for the past four years has been active in war work for **Bryant Heater Company**, has returned to its engineering department in direct charge of gas heating equipment development work. Mr. McCoy has had long experience in this field, starting with the Surface Combustion Corporation in 1926, several years after his graduation from Carnegie Institute of Technology. In 1930 he was transferred to the domestic heating division of that company, and in this capacity was responsible for design of conversion burners, unit heaters, central heating furnaces, burners, and circulating heaters. Mr. McCoy became associated with Bryant in 1935 and was actively engaged in the design of domestic heating equipment until the beginning of war work in 1940. He will head the gas heating division and will devote his efforts to improvement of these products for the post-war period.

J. A. Cerny

P. W. McCoy

J. A. Cerny, who was on leave of absence from Bryant with Columbia University Division of War Research, has returned to resume supervision of the control division of Bryant. He graduated from Case School of Applied Science in 1926. After engineering experience in development of oil purifying equipment and electric transmissions for heavy duty automotive equipment, Mr. Cerny entered the heating field in 1929 with the Bishop & Babcock Mfg. Co., Cleveland, in charge of their blower division engineering. In 1935 he became chief engineer in charge of thermostatic control development for Titan Valve & Mfg. Company. He became associated with Bryant in 1940 and was in charge of control development before leaving for war work at New London. He has now resumed this work and will be directly in charge of all control developmental activity. At the present time, Mr. Cerny is assisted in this activity by **Fred W. Schulmeister** and **Noel Green.**

In view of the transportation and hotel situation which has lead ODT to restrict meetings and conventions, the board of directors of **Copper and Brass Research Association** has voted to abandon its 25th annual meeting scheduled for May 17. Election of officers, approval of budget and other questions will be acted upon by mail.

R. E. Sprenkle has been appointed hydraulic engineer of **Bailey Meter Company**, Cleveland, Ohio. He will continue to act as consultant on all problems of fluid flow and will supervise research on such problems.

R. E. Sprenkle

Mr. Sprenkle has been associated with Bailey Meter Company for over twenty years during which time he has conducted investigations in the hydraulic laboratories of numerous engineering schools, and has served for many years as a member of the A.S.M.E. Research Committee on Fluid Meters.

Despatch Oven Company, Minneapolis, Minn., has moved into its new office building in that city. The building, 70 x 80 ft., of one floor with basement, is windowless and air conditioned by a system designed by W. B. Thornton, research engineer of the company, and has General Electric, McQuay, and Johnson Service equipment.

A new research laboratory will be constructed in Brecksville, Ohio, by **The B. F. Goodrich Company** on a tract of land adjoining the Cleveland-Akron highway. Brecksville is 20 miles from the company's operations in Akron.

Architects have completed principal plans and designs and construction work will be started as soon as possible, according to Dr. H. E. Fritz, company research director.

Airtemp Division, Chrysler Corporation, has purchased certain assets of the **Stokol Division of the Schwitzer-Cummins Company,** Indianapolis, Ind., and will use its machinery, tools and inventory for the production of Stokol stokers and other equipment. Announcement was made by D. W. Russell, president of Airtemp, following negotiations just concluded with officials of the Schwitzer-Cummins Company, including Louis Schwitzer, Sr., president. Airtemp, which operates a main plant and headquarters at Dayton, Ohio, is devoting its facilities to the production of war-essential air conditioning and refrigerating units. Included in the negotiations was acquirement by Airtemp of all Stokol patents and trademarks, and a two-year lease on the Stokol plant. The new company has been named **Stokol Stoker Company, Inc.,** and will continue to merchandise Stokol stokers. **J. A. McDaniel**, sales manager for the Stokol Division, has been appointed vice-president and general manager. The new company will operate independently of Airtemp, and continue to merchandise Stokol stokers for commercial and domestic use, and to provide service for many thousands of Stokol stokers now in use.

J. D. Mattimore, director of research and development for Tube **Turns, Louisville, Ky., announces appointment of Arthur R. C. Markl** as chief research engineer. Before joining Tube Turns, Mr. Markl was for fourteen years associated with M. W. Kellogg Company, New York, last in charge of the development of equipment for oil refineries.

A. R. C. Markl

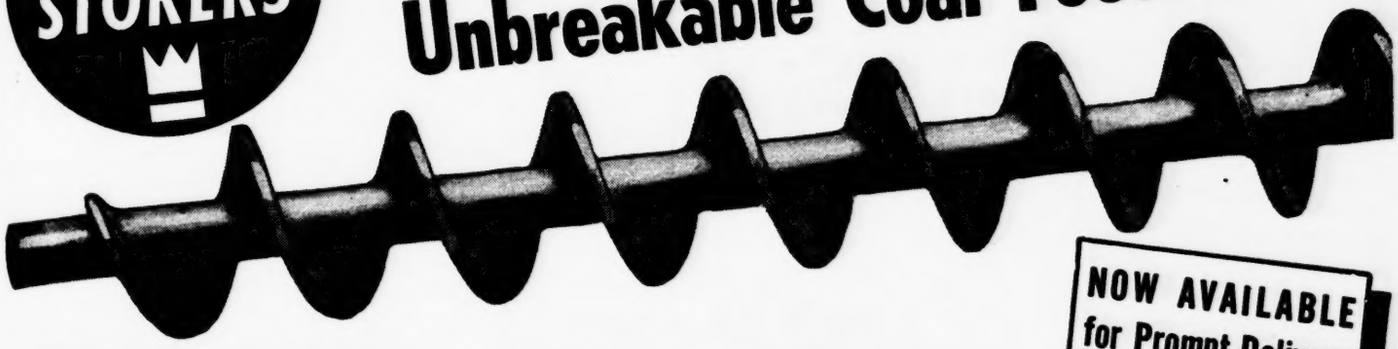
The Buffalo, Cleveland, Kansas City, and St. Louis district offices and showrooms of **Armstrong Cork Company** have been moved into new quarters. The New Orleans district offices and showrooms are also in new quarters, but at the same location, 928-930 Tchoupitoulas Street. Buffalo offices have been moved from 329-331 Ellicott Street to 822 Genesee Building, Buffalo 2. Cleveland offices, formerly at 708-716 Caxton Building, 812 Huron Road, are now at 209 Hanna Building Annex, Prospect Avenue and 14th Street, Cleveland 15. Kansas City offices have been moved from 1535 Walnut Street to 800 New York Life Building, Kansas City 6. St. Louis offices, formerly at 1215 Washington Avenue, are now in the Union Electric Company Building, 1205 Olive Street, St. Louis 3.

Rodney F. Lauer, manager of the Washington national service office of **York Corporation**, has been named district manager of the company's California operations with headquarters in Los Angeles. He began work in the refrigeration and air conditioning plants of York while still an undergraduate at Cornell University. On his graduation as a mechanical engineer in 1930, Mr. Lauer joined the company as a student engineer and remained in the factory until 1934. He was then assigned to the Philadelphia branch and worked there as an application engineer and later as sales manager of Southern District of that territory until 1942 when he became manager of the Washington office.

Rodney F. Lauer

For STOKERS

The CROWN Unbreakable Coal Feed Screw



NOW AVAILABLE for Prompt Delivery

WELDED All-Steel Worm—All Sizes—All Pitches

★For replacement or production needs, Crown is now able to offer for prompt delivery its all-steel Coal Feed Screw. Available with right or left hand screw, in all sizes and pitches, tapered or straight, and in combinations of pitches. For both domestic and industrial stokers, the Crown Coal Feed Screw insures longer and continuous operation because it is all-steel and because it is machined so smoothly that wear is reduced to a minimum. This smooth surface is your assurance, too, that coal will flow freely and easily through the flights. Prompt delivery is possible because production requires less time on Crown's automatic machines and because the steel used in Crown's Coal Feed Screw while critical, is more easily procured.

In ordering give complete specifications on size and design.

CROWN IRON WORKS COMPANY

1229 Tyler St., N. E. *Since 1878* Minneapolis, Minn.

AIR CONDITIONING NOZZLES

Nozzles of unique Yarway Involute Design.

No internal parts or vanes to clog or erode.

Insure trouble-free air washing service.

Sizes and types for all requirements.

Many large users—installations total more than 5 million gallons per minute in water cooling and air conditioning service. Write for Bulletin N-616.

YARNALL-WARING COMPANY
104 MERMAID AVENUE
PHILADELPHIA 18, PA.

YARWAY

SARCO

AIR ELIMINATORS

In Vapor Systems, air is eliminated from radiators and piping at one central point in the basement by the eliminators shown. This method assures rapid and noiseless removal of air so that the system will heat up quickly on minimum pressure.

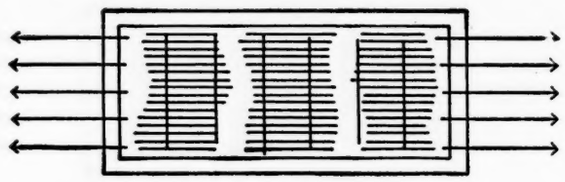
Spilling of water is prevented by a float valve, while a check-valve prevents sucking in of air under vacuum. Above we show Type 12-A, capacity 15,000 sq. ft. At left: No. 5, capacity 2,000 sq. ft. Ask for Catalog No. 170.

SARCO SAVES STEAM

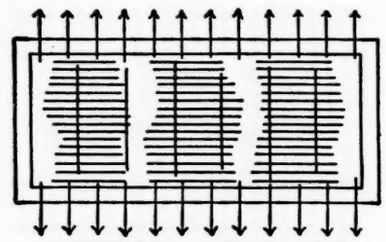
SARCO COMPANY, INC.
475 Fifth Avenue, New York 17, N. Y.
SARCO CANADA LTD. 85 Richmond St. W. TORONTO ONT.

188

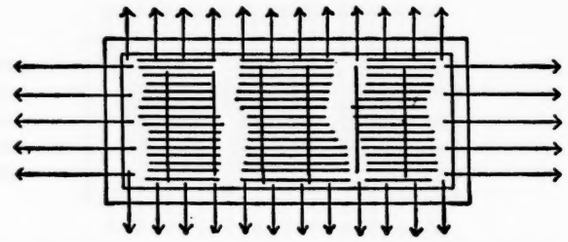
One Register does all this:



HORIZONTAL AIR FLOW



VERTICAL AIR FLOW



BOTH HORIZONTAL AND VERTICAL

. . . when it's a

One register serves all sizes—all shapes of rooms when you specify *Waterloo* . . . Because Waterloo's individually adjustable blades will direct the air flow in 1-2-3 or 4 directions at the SAME time, and with equal efficiency. And Waterloo's streamlined blades hold noise to a minimum. For maximum efficiency and smartness, today and post-war, specify Waterloo "registers of the future".

Waterloo REGISTER CO.

Established 1902

Waterloo, Iowa Seattle, Wash.

Representatives in all principal cities.

Edward I. Williams of Front Royal, Va., elected at the annual meeting in December, assumed his new duties as president of the **National Mineral Wool Association** on January 1. He succeeds T. C. Carter of Cincinnati.

Mr. Williams, a mining engineer who was graduated from Columbia University in 1914, president of the Riverton Lime & Stone Co., Riverton, Va., also served as chairman of the Mineral Wool Industry War Council and industry consultant to WPB. Previously he was president of the Industrial Mineral Wool Institute.

Other officers and directors of the National Mineral Wool Association for 1945 are M. G. Jensen, vice-president, Owens-Corning Fiberglas Corporation; W. H. Hill, treasurer, Baldwin-Hill Co.; T. C. Carter, director, Eagle-Picher Sales Company; L. M. Cassidy, director, Johns-Manville Sales Corp.

The Chicago office of **Alco Valve Company** has been reopened, with **John A. Schenk** taking over as field engineer. Mr. Schenk previously managed Alco's Chicago office from 1936 until it was closed by war restrictions in April, 1942. Since that time he has been at the home plant in St. Louis, where he handled priority material allotments, production coordination, and later served as application engineer. Mr. Schenk joined Alco in January, 1935. He spent a year in the engineering department working on research and design before going to Chicago. The Chicago office, located at 866 Civic Opera Building, 20 North Wacker Drive, will carry no stock.

John A. Schenk

Viking Air Conditioning Corp. has appointed **Norman S. Wright & Co.** as Pacific Coast representatives. The Wright organization, 41 years old, is headed by **Norman S. Wright, Sr.,** in charge of the main San Francisco office. General manager of the firm is **Norman S. Wright, Jr.,** and **E. D. Law** is office manager of the San Francisco branch. **John M. Haas, Walter H. Page** and **Ed Lokey** are managers of the Los Angeles, Seattle and Portland branch offices, respectively.

Bunting Industrial Sales has moved its offices to Bunting Industrial Sales Bldg., S. Capitol Ave., Lansing 15, Mich.

A. H. Lockrae has been appointed manager of the heating controls division of **Minneapolis-Honeywell Regulator Co.** Mr. Lockrae will have charge of the company's activities in the sale of oil burner, stoker and gas controls and, in addition, will supervise sales to wholesalers and dealers. Joining the company in 1927 when the Honeywell Heating Specialties Company merged with the Minneapolis Heat Regulator Company to form the present organization, Mr. Lockrae has been associated with sales and branch office activities until the present time. The appointment follows the death of John W. Pauling January 17. Mr. Lockrae, who has been sales manager of the division, will take over all duties formerly performed by Mr. Pauling.

A. H. Lockrae

At the nineteenth annual meeting of the **Industrial Unit Heater Association** held at Boston January 25, the following officers were elected for the ensuing year: **F. P. Kohlbry,** president; **N. Downey,** vice-president; and **L. O. Monroe,** secretary-treasurer. Mr. Kohlbry is president of the Airtherm Mfg. Co., St. Louis; Mr. Downey is manager of the unit heater division, The Trane Company, La Crosse.

Minneapolis-Honeywell Regulator Company has formed a new sales zone, with headquarters in Houston, Texas. The zone will encompass the territory in the Southwest formerly under jurisdiction of the Atlanta zone and will maintain offices in Houston, Dallas, Tulsa and New Orleans. **Robert Mallory,** formerly branch manager of the Houston office, has been named as manager for the new Southwestern zone.

Owens-Corning Fiberglas Corp. announces, effective February 1, changes in branch personnel: **Ben S. Wright,** since November, 1940, manager of the Fiberglas fabrics division in the Toledo general offices, has been transferred to Cleveland as manager of the firm's branch office, 825 Hanna Building. Mr. Wright has specialized in field development work. He succeeds **W. H. Atkinson,** who becomes manager of the Fiberglas Corporation's Chicago branch office, 3206 Pure Oil Building. Mr. Atkinson has been affiliated with the Fiberglas Corporation since it was formed in 1938. Previous assignments included research laboratories staff, the Fiberglas electrical division, and manager of the Pittsburgh Branch office for two years prior to his transfer to Cleveland in 1943.

Ben S. Wright

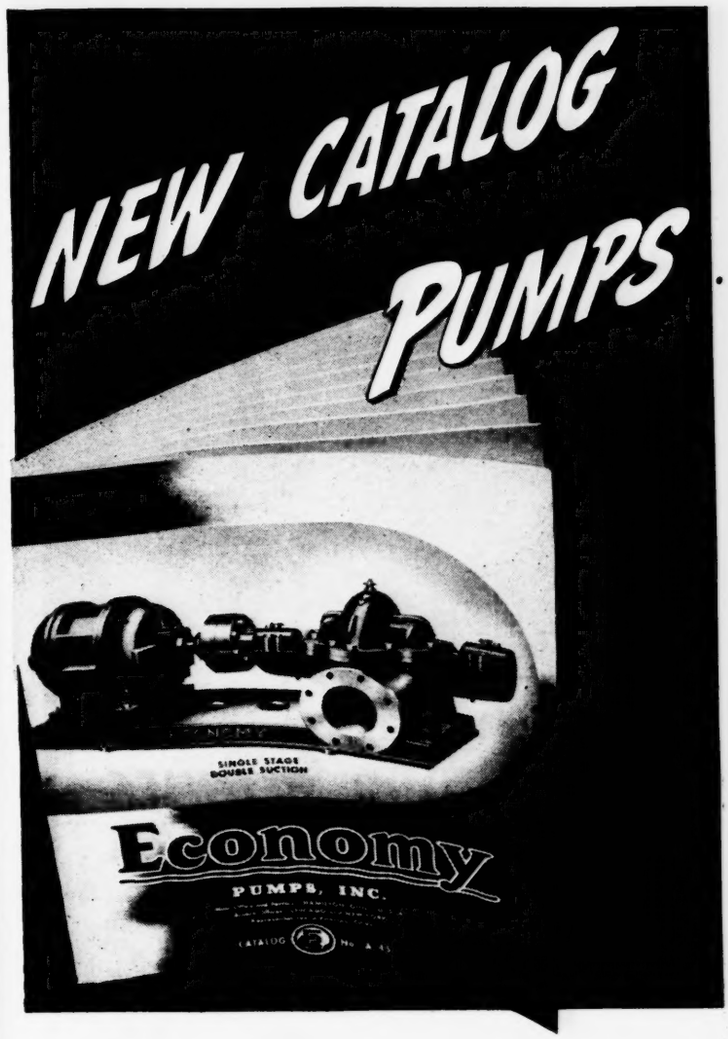
Mr. Atkinson succeeds **Frank L. Myers** as Chicago branch manager. Mr. Myers has been associated with the development and sale of Fiberglas products since they were first marketed commercially 13 years ago. He has managed the Company's Chicago branch office since November, 1938.

Mr. Myers will return to the company's general offices to join the general sales organization. He will be engaged on special assignments in the field of thermal insulation, adapting standard Fiberglas products to new applications. In his new post, Mr. Myers will be on the staff of J. H. Thomas, general sales manager.

Another staff change announced today is the return to the Toledo general offices of **Earl Swaim,** formerly Buffalo branch manager. Mr. Swaim is associated with G. E. Gregory, vice-president in charge of commercial development.

Carl Fritsche of East Orange, N. J., has been added to the direct factory sales organization of **H. A. Thrush & Co.,** Peru, Ind. He has had many years experience in the heating business.

At the annual meeting of the **Midwest Stoker Association,** Chicago organization of stoker distributors and service agencies, held at the Builders' Club February 7, all incumbent officers and members of the board of directors were re-elected for another term expiring January 1, 1946. The officers re-elected were as follows: **John J. Hayes,** president, of the Auburn Stoker Company; **William J. O'Neil,** vice-president of the Iron Fireman Mfg. Co.; and **Joseph G. Beard,** secretary-treasurer, of the Illinois Iron and Bolt Company. Members of the board of directors re-elected were as follows: Messrs. Hayes, O'Neil and Beard; **F. H. Herndon,** of the Link-Belt Company; and **F. J. Moran,** of C. E. Sundberg Company. The Association approved a course of instruction on the care and operation of underfeed stokers prepared by its Engineering Committee, which will be given before several thousand Chicago flat janitors at a series of meetings to start in April or May in cooperation with officials of the Chicago Flat Janitors' Union. Instructors will be members of the Association's Engineering Committee. Sample copies of the instruction course will be made available to other stoker and allied trade organizations after the schools for janitors in Chicago have been completed.



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- NEW FEATURES OF DESIGN
- NEW PERFORMANCE ACHIEVEMENTS
- NEW SIZES AND CAPACITIES
- NEW APPLICATIONS

Catalog A-145, just off the press, covers an entire range of Centrifugal Pumps, especially engineered for industrial, municipal and other water supply systems. Cross-section illustrations, performance curves and structural details show at a glance why users of Economy Pumps save in cost, power, labor. Selection tables simplify the choice of exact types and sizes to handle specific requirements. A copy of the catalog is yours for the asking, on your letterhead. So are the services of our engineering staff—for special problems—without obligation.

SEND FOR YOUR COPY TODAY!

ECONOMY PUMPS, INC.
HAMILTON, OHIO • U. S. A.
OVER THIRTY YEARS MAKING BETTER PUMPS

You'll have to *WATCH YOUR PENNIES* in the PEACETIME COMPETITION

With the coming of peace and a return to the American way of producing goods at a profit in highly competitive consumer markets you'll *have* to be certain that every step from initial blueprint and tool design, through the machining, stamping and assembly line, up to packaging and delivery is planned and executed with utmost efficiency and with the minimum of cost.

In the production of war munitions Oiljak has maintained an enviable record of production of intricate parts and on time deliveries, in accordance with strict Government inspection—and has actually reduced the estimated and approved cost, thus saving the Government considerable sums, by skillful planning and supervision of the work. These same skills in metal manufacturing, improving designs and reducing costs are available to manufacturers as they convert to peacetime merchandise. It may transmit your penny savings into dollar profits to confer with us on any metal manufacturing problem.

Machining • Stamping • Welding • Plating • Finishing • Assembling

The OILJAK Mfg. Co., Inc.

ARMY NAVY

MONTCLAIR, N. J.
METAL MANUFACTURERS

THE JOB COMPLETE . . .
from blueprint to finished product

Homestead Valve Manufacturing Co., Inc., Coraopolis, Pa., has started production in its new cleaning-compound manufacturing plant at Edgeworth, Pa., across the Ohio River from the company's main plant.

John P. Johnston has joined the **Weatherhead Company** as refrigeration engineer for the West Coast office in Glendale, Calif.

John P. Johnston

During the past five years, Mr. Johnston was engaged in design engineering at the Douglas Aircraft Company of California, where he conducted research on the application and design of equipment for heating and air conditioning aircraft. Prior to that, he spent six years in the heating and refrigeration industry and was associated with Carrier Corporation of Syracuse, N. Y., in research and field engineering.

Rae F. Bell, former first vice-president of the **A. O. Smith Corp.,** has been elected chairman of the firm's board of directors to succeed the late L. R. Smith, president W. C. Heath announced Jan. 12. Mr. Bell was elected by the board of directors at its meeting Jan. 11. He started with the corporation in 1923 as a vice-president, and in 1937 was elected first vice-president, He became a board member in 1925.

At the same meeting Anthony von Wening, formerly a vice-president of the Continental Illinois National Bank & Trust Co., of Chicago, who joined the A. O. Smith Corp. in 1940, was elected vice-president and controller. Other officers were reelected.

Getting Personal

Dwight Tenney

Dwight Tenney (Refrigeration and Air Conditioning Required in Bread Bakeries, page 55) is a consulting engineer specializing in sub-zero refrigeration and food processing equipment.

Born in New York City, he was schooled in Montclair, N. J., and graduated as a Chemical Engineer from Columbia School of Mines in 1914. On leaving college, he helped bake crackers at the National Biscuit Company, leaning toward the mechanical side of the business. He served on the Mexican Border with the "Old Seventh" regiment NYNG and in World War I as a Lieutenant in the Transport Force.

As chief engineer for the Franklin Baker Company (now General Foods) he introduced "New York atmosphere" to Manila, P. I., in 1923 and helped make possible the first quality production of desiccated cocoanut in the Philippine Islands. Served as assistant engineer for a short time with the Continental Baking Company. In 1932 he organized Tenney Engineering, Inc., with a staff of three. This company manufactures air conditioning equipment for bakeries, ventilation heaters for Naval vessels, and with the coming of World War II pioneered in the development of stratosphere chambers. He nursed this company along until its payroll jumped in 1943 to over 100 persons. He sold out his interest and is now taking life easy at his home in Verona, N. J., where he is conducting a consulting practice.

COMING EVENTS

APRIL 16-18—Spring meeting of the American Society of Mechanical Engineers, Boston, Mass. Secretary-C. E. Davies, 29 W. 39th St., New York 18, N. Y.

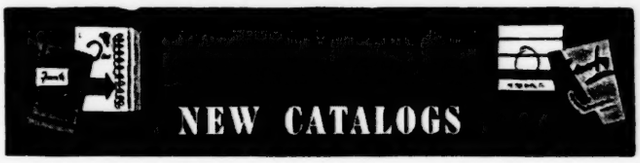
JUNE 10-13—Summer convention of the American Society of Refrigerating Engineers to be held at the Hotel Schroeder, Milwaukee, Wis. Secretary David L. Fiske, 50 W. 40th St., New York 18, N. Y.

JUNE 17-21—Semi-annual meeting of the American Society of Mechanical Engineers, Chicago, Ill. Secretary, C. E. Davies, 29 W. 39th St., New York 18, N. Y.

JUNE 18-21—38th Annual convention of the National Association of Building Owners and Managers, to be held at the Hotel Statler, Cleveland, Ohio.

SEPTEMBER 17—Third Wartime Conference and 74th Annual meeting of American Public Health Association to be held at the Hotel Stevens, Chicago, Ill. Executive secretary, Reginald M. Atwater, M.D., American Public Health Association, 1790 Broadway, New York 19, N. Y.

OCTOBER 1-3—Fall meeting of the American Society of Mechanical Engineers, Cincinnati, Ohio. Secretary, C. E. Davies, 29 W. 39th St., New York 18, N. Y.



Oxy-Acetylene Systems

An 84-page book giving a comprehensive review of oxy-acetylene pipeline distributing systems, from the production of calcium carbide and acetylene gas to the equipment needed for oxy-acetylene distributing systems—replete with illustrations, charts, and easily read engineering data. Circulation of this book is restricted to engineers and welding department supervisors.—*Victor Equipment Co., 844 Folsom St., San Francisco 7, Calif.*

Oil–Gas Burners

A standard size, 4-page bulletin 902 devoted to the company's type M gas burner and combined gas and oil burner. Describes and illustrates the mechanical and operating features of these burners, for natural or forced draft operation, and also shows the types of atomizers used for oil firing.—*Peabody Engineering Corp., 580 Fifth Ave., New York 19, N. Y.*

Spreader Type Stoker

Bulletin 441-S, an illustrated folder, describes the J & J spreader type stoker which has a dust tight coal feeder, and a combination mechanical-pneumatic coal distributing system to distribute lump and fines to all parts of the grate area.—*The Johnston & Jennings Co., 877 Addison Rd., Cleveland 14, Ohio.*

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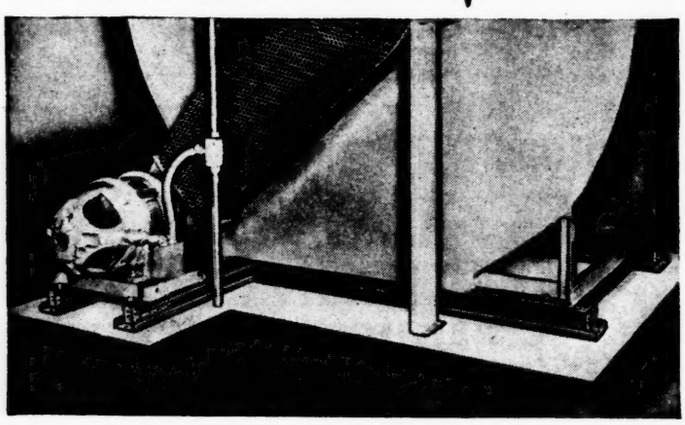
Korfund Vibro-Bar Integral Base installed under a fan and motor.



Waterproof Compound

Illustrated folder to show how Flextite can be applied to concrete, brick or masonry for waterproofing and for stopping water leaks.—*Flexrock Co., Filbert and Cuthbert, West of 36th, Philadelphia 4, Pa.*

Controls

A 4-page standard size, loose-leaf punched bulletin covering sheets 1100-1103, inclusive, and devoted to the company's electronic level controls for liquids and powders. Gives differential, hook-up sizes and capacity data.—*Photoswitch Inc., Cambridge 42, Mass.*

Protected Motors

Four-page bulletin describing the company's protected type motor and including a cutaway view of the device showing how this construction provides a protection against many common hazards encountered in operation.—*Crocker-Wheeler Division of Joshua Hendy Iron Works, Ampere, New Jersey.*

Boiler Walls

Standard size, 4-page folder entitled "A Crack . . . and the wall loses its value," and illustrating and describing the advantages of the company's sectionally supported boiler wall.—*Geo. P. Reintjes Co., P. O. Box 856, Kansas City, Mo.*

Color Selection Guide

A new and simple color selection guide to enable industrial engineers to specify correct color shades that minimize fatigue and promote safety. Developed for use in industrial, commercial and institutional interiors, the method enables anyone confronted with a painting job to make his own selections on a scientific basis which insures the maximum benefits obtainable through the use of color. Reduces color selection problems to 18 short and simple rules. Published as an overall practical guide to the use of the Optonic color system.—*The Arco Co., Cleveland, Ohio.*

Space Heaters

A 12-page folder, 4 by 8½ in. and entitled "A Primer on Space Heaters," prepared for the layman to acquaint him with the types, functions and applications of domestic space heaters. The booklet describes the types of space heaters, where they are used, what determines installations, and how to choose a space heater.—*Evanair Division, Evans Products Co., Detroit 27, Mich.*

Steam Heating

Bulletin 3634, entitled "Dunham General Products Bulletin of Low Pressure Steam Heating Appliances", and consisting of 60 pages of catalog information and 26 pages of engineering data. The catalog section includes descriptive, illustrative, capacity and dimensional data on the Dunham differential system, the company's line of thermostatic float and bucket traps, strainers, radiator valves, vacuum pumps, condensation pumps and receivers, centrifugal pumps, vertical and floor type unit heaters, convectors and fittings, pressure reducing valves, air eliminators. Engineering data include information on design of heating systems, heat transmission, weather data, degree days, heat exchange from piping, copper tubing data, a short method of figuring heat loss, fuel, pipe fitting and drafting room data. Indexed with cutaway index tabs.—*C. A. Dunham Co., 450 East Ohio St., Chicago, Ill.*

Air Handling Equipment

A compact and conveniently arranged condensed catalog and engineering data book totaling 200 pages, with a psychrometric chart folded in the back. Size 4¼ x 9 in., entitled "What We Make," and listed as catalog No. 500. Photographs, brief capacity table and descriptions, all well indexed, appear for each of the different types of the company's fans, air washers, cooling coils, heating coils, ventilators, heaters, unit ventilators and other types of air handling equipment. The engineering section includes 35 pages of applications and classified under such headings as shop buildings, industrial heating and ventilating, vapor absorption systems, industrial air conditioning, railroad applications and so on. The engineering section summarizes fan fundamentals and fan losses, how to determine the resistance of a fan system, data on losses in elbows, and many other data pertinent to air handling, combustion, air conditioning and allied subjects. A limited supply only is available to those requesting booklet on their letterhead.—*B. F. Sturtevant Co., Inc., Hyde Park, Boston 36, Mass.*

Air Diffusers

A 76-page, standard size bulletin entitled "Kno-Draft Adjustable Air Diffusers." Contains sketches, charts, constructive text and dimension prints, together with data on selection, application, location, assembly, erection, adjustment, and testing air diffusers. Set up in durable loose leaf binder. Separate sections are devoted to accessory equipment such as dampers, mounting rings and baffles.—*W. B. Connor Engineering Corp., 116 E. 32nd St., New York 16, N. Y.*

Fans and Blowers

Two condensed bulletins, F-9 covering ventilating and duct type fans, and bulletin SW-1 covering forced draft blowers both turbine driven and motor driven and Wing auxiliary turbines. Former, 8 pages, describes Wingfoil fan wheel, straight line duct fan, and elbow type duct fan. Elbow duct fan is a new development, formerly called an exhauster. Bulletin includes descriptions of installations, dimensional, capacity and other engineering data. Bulletin SW-1, 8 pages, includes photographs of installations, capacity curves, dimensional tables, and operating data.—*L. J. Wing Mfg. Co., 57 Seventh Ave., New York 11, N. Y.*

Condensers

An 8-page bulletin, Form 9012, titled "Barometric Condensers." It covers both the disc-flow and ejector-jet types, explaining the uses, advantages and operation of each. Several schematic diagrams illustrate how these vacuum-producing systems work and a number of photographs show the condensers in various industries such as chemical, fertilizer, sugar and power plants.—*Ingersoll-Rand Co., Phillipsburg, N. J.*

Condensers

Single sheet, standard size, loose leaf punched bulletin 99 containing diagram of operation of the company's Aero steam condenser, printed in four colors.—*Niagara Blower Co., 6 E. 45th St., New York 17, N. Y.*

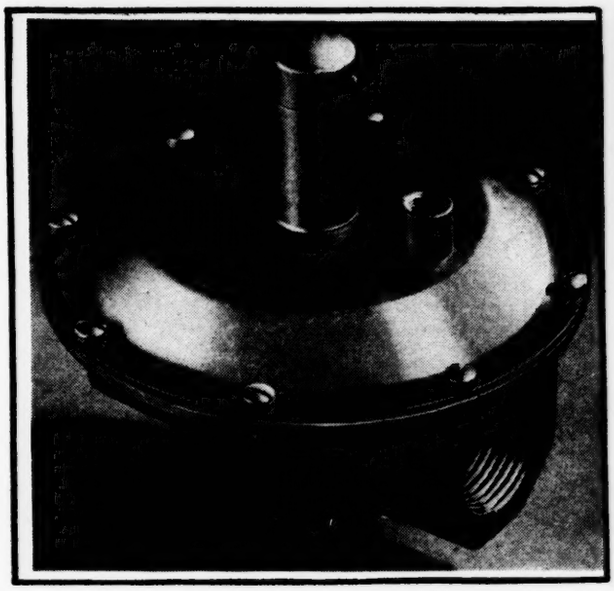
Refrigeration Valves

A 4-page, standard size folder, Bulletin V-200 devoted to the company's refrigeration valves and strainers and covering thermal expansion valve type V-200 for Freon, methyl chloride and sulphur dioxide, K-10 and K-15-6 series magnetic liquid and suction stop valves, and the SA, SG and S-5 series of strainers. Includes drawings, photographs, capacity and dimensional data.—*General Controls Co., 801 Allen Ave., Glendale 1, Calif.*

GENERAL CONTROLS

V-300

Low Pressure Gas Regulator



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V-300 *CLOSE REGULATION*

V-300 *NOMINAL COST*

Here is a low pressure Gas Regulator that answers every requirement for a small, compact, high quality regulator that will provide high capacity and close regulation, yet be reliable and trouble-free.

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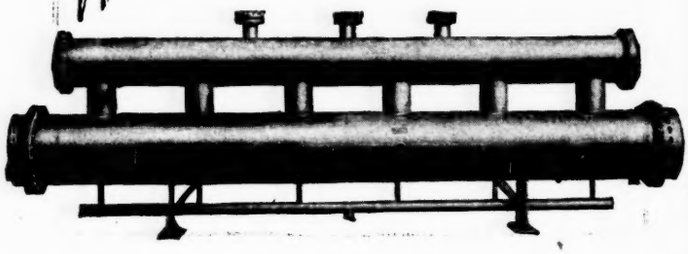

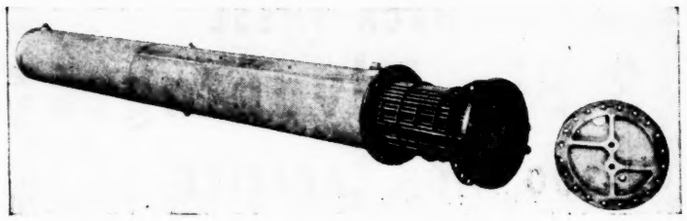

This is an engineering specialty in itself . . . a specialty that calls for an understanding not only of heat transfer phenomena but of refrigerants and their behavior. Calculations are not as simple as 2 + 2 = 4.

That Patterson-Kelley is looked upon as specialists in this field is evidenced by the many "coolers" provided for refrigerating and air-conditioning systems throughout the country.

If you have any problem along these lines, or are working on some project, we would like to help.

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Heaters and Coolers

A 12-page letter size bulletin No. 37-76B on Adsco heaters and coolers. Three new types are described.—*American District Steam Co., North Tonawanda, N. Y.*

Air Control

Illustrated folder describing an air control for shallow well pumps. Control is for applications up to 80 lb per sq in. tank pressure. The valve has stainless orifice and is completely sealed.—*Manning, Maxwell & Moore, Inc., Electro-Mechanical Division, Bridgeport 2, Conn.*

Belting

An informative transmission and conveyor belting chart which provides a rapid reference for standard belt thicknesses and includes full information as to fastener and lacing sizes for each thickness. All commonly used belting materials are covered—leather, cotton woven, canvas and balata, rubber.—*Baldwin Belting, Inc., 85 Chambers St., New York, N. Y.*

INDUSTRIAL DEGREE-DAYS

January, 1945

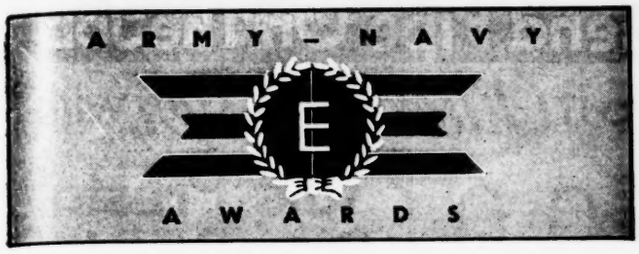
City	55F Base	45F Base
Baltimore, Md.	762	452
Buffalo, N. Y.	1204	894
Chicago, Ill.	1017	707
Cleveland, Ohio	1088	778
Detroit, Mich.	1155	845
Indianapolis, Ind.	945	635
New York, N. Y.	918	608
Philadelphia, Pa.	878	568
Pittsburgh, Pa.	944	634
St. Louis, Mo.	814	504

Canadian Degree-Days for January, 1945*

City	January 1945	January Normal	Cumulative, Sept. 1 to Jan. 31 1945	Cumulative, Sept. 1 to Jan. 31 Normal
Calgary, Alta.	1426	1609	4555	5311
Charlottetown, P. E. I.	1355	1463	4080	4328
Crescent Valley, B. C.	1094	1352	3972	4631
Edmonton, Alta.	1686	1832	5396	5814
Fort William, Ont.	1934	1807	5473	5622
Grand Prairie, Alta.	1528	1841	5499	6000
Halifax, N. S.	1178	1308	3533	3941
London, Ont.	1624	1336	4489	4013
Medicine Hat, Alta.	1550	1643	4945	5032
Moncton, N. B.	1445	1528	4479	4714
Montreal, P. Q.	1829	1587	5064	4683
North Bay, Ont.	1987	1658	5555	5161
Ottawa, Ont.	1894	5216	1646	4923
Penticton, B. C.	983	1184	3506	3810
Porquis Junction, Ont.	2251	2052	6304	6300
Prince George, B. C.	1414	1615	5080	5372
Quebec City, P. Q.	1767	5002	1696	5207
Regina, Sask.	1820	2037	5676	6373
St. John, N. B.	1401	1417	4215	4386
Saskatoon, Sask.	1879	2027	5733	6276
Toronto, Ont.	1549	1302	4140	3953
Vancouver, B. C.	760	2888	893	3061
Victoria, B. C.	685	815	2460	2725
Windsor, Ont.	1507	1283	3907	3729
Winnipeg, Man.	1894	2111	5669	5316

*These data are supplied through the courtesy of the Meteorological Division, Air Services Branch, Department of Transport, Canada, with the cooperation of N. W. Etter, Heating Engineer, Enamel & Heating Products Limited, Sackville, N. B.

The Department reports some slight revisions in the figures for December, as published in last month's issue. Corrected figures are: Charlottetown, P. E. I., 1265; Grande Prairie, Alta., 1565; Montreal, P. Q., 1590; North Bay, Ont., 1587; Penticton, B. C., 1122; St. John, N. B., 1276; Vancouver, B. C., 865; and Victoria, B. C., 735.



Peerless Pump Division of Food Machinery Corp., Los Angeles, Calif. (Second award)

The Oiljak Manufacturing Co., Inc., Montclair, N. J. (Second star)

American Machine and Metals, Inc., East Moline, Ill. (Third award)

Cochrane Corporation, Philadelphia, Pa. (Second star)

GASOLINE PIPING AND STORAGE

(Continued from page 88)

which the pump must operate is the sum of the suction lift and discharge head—

Vertical suction lift	= 9.9 feet of gasoline
Friction in suction line	= 2.2 feet of gasoline
Vertical discharge head	= 38.0 feet of gasoline
Friction in discharge line	= 47.0 feet of gasoline
Total	= 97.1 feet of gasoline

Substituting in equation (4)

$$HP = \frac{G \times H \times s}{1785} = \frac{85.8 \times 97.1 \times 0.7}{1785} = 3.27$$

As a motor will operate continuously at a slight overload without overheating, a 3 hp motor will be satisfactory. Specifications for pumps are seldom required to the accuracy of decimals, so that a slight rounding out of the above results is justified and the pump will be specified as follows:

Capacity	90 g.p.m. 100 octane gasoline
Suction lift	12 feet of gasoline
Discharge head	85 feet of gasoline
Motor size	3 horsepower

It can be shown that if larger lines were installed for the delivery main so as to reduce the friction loss 50% the computed horsepower would be 2.50 so that a 3 hp motor would still be the correct specification.

If the gasoline were to be delivered by the hydraulic method the water pressure at the storage tank would have to be

$$85 \times 0.7 \div 2.31 = 25.8 \text{ lb per sq in,}$$

to which must be added the friction drop through the special control fittings and in the water supply system to obtain the reduced pressure at the pressure regulator. Should the computed water pressure exceed the available plant supply pressure the water and gasoline lines can be increased in size to reduce the friction loss and thus decrease the system demand pressure.

The concluding section on Gasoline Piping and Storage will present information on safeguarding of systems.

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Proven, rugged, modern design. Quiet, guaranteed for use on #150 p.s.i. steam pressure. Heating element, individual spiral fin tubes free to expand without strain on joints. Standard motors with standard bases used. Ten models.
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